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ART. I.—*Nereis Boreali-Americana; or Contributions to a History of the Marine Algæ of North America;* by WM. HENRY HARVEY, M.D., &c.—Part I. MELANOSPERMEÆ. Washington, Smithsonian Institution. New York: G. P. Putnam. Jan., 1852.

THIS is the first part of the work announced in our January number. It is a separate issue of a Memoir (of 150 pages, with 12 plates) contained in the forthcoming third volume of the *Smithsonian Contributions to Knowledge;* and a welcome contribution it is, as well in its purely scientific bearings, as on account of the popular interest of the subject; and under both aspects well deserving the efficient furtherance of this admirably managed institution, since the heavy outlay for the needful pictorial illustration would deter any unaided author or publisher.

Algæ are especially interesting to the structural anatomist and physiologist, from their consisting either of isolated cells or series of cells in their simplest combination, often of considerable size, and developed under circumstances very favorable to microscopic investigation; therefore affording the readiest elucidation of cell-formation, and of the most universal laws of growth and reproduction, the understanding of which forms the true groundwork of physiology, whether animal or vegetable. Studied less profoundly, and in view of their infinitely varied and beautiful forms and systematic arrangement, this class of plants has attracted more popular interest perhaps than any other, at least in Great Britain, where their study has been encouraged and facilitated by the various illustrated works which the Algæ par-

ticularly require. This general interest, first incited by Dr. Greville's *Algæ Britannicæ*, has been widely extended by Dr. Harvey's own Manual of the British Algæ, especially the second edition, and his elaborate *Phycologia Britannica*. The plates of the latter are excelled only by those of the present memoir, in which Professor Harvey is doing for our country what in those works he has accomplished for his own, and what in his *Nereis Australis* he is likewise doing for the counterpart regions of the southern hemisphere. As we welcome this accomplished naturalist as a fellow-laborer on our own ground, let us hope that this first is far indeed from being the last "Contribution to knowledge" from a transatlantic source to be called forth and published by the Smithsonian Institution. Such scientific intervention is productive only of good results.

The book now before us, in the form of a thin quarto volume, is only the first part of the work, comprising the *Melanospermeæ*, or olive-colored seaweeds, with the general introduction. Two more parts, still more ample, or at least embracing a greater variety of forms, are yet to come; namely, part 2d, the *Rhodospermeæ*, or Rose-red Algæ; and part 3d, the *Chlorospermeæ* or Grass-green Algæ. Both of these, and especially rose-red series, already in a state of forwardness, will furnish more striking illustrations than the present, for the olive-colored seaweeds are not remarkable for beauty. They are however, generally, the most conspicuous for size, and the most important in their economical uses.

In speaking of the uses of seaweeds, Prof. Harvey very properly alludes, first to the general office which this class of plants discharges in the economy of nature.

"The part committed to the Algæ in the household of nature, though humble when we regard them as the lowest organic members in that great family, is not only highly important to the general welfare of the organic world, but, indeed, indispensable. This we shall at once admit, when we reflect on the vast preponderance of the ocean over the land on the surface of the earth, and bear in mind that almost the whole submarine vegetation consists of Algæ. The number of species of marine plants which are not Algæ proper is extremely small. These on the American coast are limited to less than half a dozen, only one of which, the common *Eel Grass* (*Zostera marina*), is extensively dispersed.

"All other marine plants are referable to Algæ; the wide spread sea would therefore be nearly destitute of vegetable life were it not for their existence. Almost every shore—where shifting sands do not forbid their growth—is now clothed with a varied band of Algæ of the larger kinds; and microscopic species of these vegetables (*Diatomaceæ*) teem in countless myriads at depths of the ocean as great as the plummet has yet sounded, and where no other vegetable life exists. It is not, therefore, speaking too broadly to say that the sea, in every climate and at all known depths, is tenanted by these vegetables under one phase or other.

"The sea, too, teems with animal life,—that "great and wide sea, wherein are things creeping innumerable, both small and great beasts," affords scope to hordes of animals, from the "Leviathan" whale to the microscopic polype, transparent as the water in which he swims, and only seen by the light of the phosphoric gleam which he emits. Now this exuberant animal creation could not be maintained without a vegetable substructure. It is one of the laws of nature that animals shall feed on organized matter, and vegetables on unorganized. For the support of animal life, therefore, we require vegetables to change the mineral constituents of the surrounding media into suitable nutriment.

"In the sea this office of vegetation is almost exclusively committed to the Algæ, and we may judge of the completeness with which they execute their mission by the fecundity of the animal world which depends upon them. Not that I would assert that all, or nearly all, the marine animals are directly dependent on the Algæ for their food; for the reverse is notoriously the case. But in every class we find species which derive the whole or a part of their nourishment from the Algæ, and there are myriads of the lower in organization which do depend upon them altogether.

"Among the higher orders of Algæ feeders I may mention the Turtles, whose *green fat*, so prized by aldermanic palate, may possibly be colored by the unctuous green juices of the *Caulerpæ* on which they browse. But without further notice of those that directly depend on the Algæ, it is manifest that all must ultimately, though indirectly, depend on whatever agency in the first instance seizes on inorganic matter, and converts it into living substance suitable to enter into the composition of animal nerve and muscle. And this agency is assuredly the office of the vegetable kingdom, here confined in the main to Algæ; we thus sufficiently establish our position that the Algæ are indispensable to the continuance of organic life in the sea.

"As being the first vegetables that prey upon dead matter, and as affording directly or indirectly a pasture to all water animals, the Algæ are entitled to notice. Yet this is but one half of the task committed to them. Equally important is the influence which their growth exerts on the water and on the air. The well known fact that plants, whilst they fix carbon in an organized form in extending their bodies by the growth of cells, exhale oxygen gas in a free state, is true of the Algæ as of other vegetables. By this action they tend to keep pure the water in which they vegetate, and yield also a considerable portion of oxygen gas to the atmosphere. I have already stated that whenever land becomes flooded, or wherever an extensive surface of shallow water—whether fresh or salt—is exposed to the air, *Confervæ* and allied Algæ quickly multiply. Every pool, every stagnant ditch is soon filled with their green silken threads. These threads cannot grow without emitting oxygen. If you examine such a pool on a sunny day, you may trace the beads of oxygen on the submerged threads, or see the gas collect in bubbles where the threads present a dense mass. It is continually passing off into the air while the Confervæ vegetate, and this vegetation usually continues vigorous, one species succeeding another as it dies out, as long as the pool remains. And when, on the drying up of the land, the Confervæ die, their bodies, which are scarcely more than membranous skins filled with fluid, shrivel up, and

are either carried away by the wind or form a papery film over the exposed surface of the ground. In neither case do they breed noxious airs by their decomposition. All their life long they have conferred a positive benefit on the atmosphere, and at their death they at least do no injury. The amount of benefit derived from each individual is indeed minute, but the aggregate is vast when we take into account the many extensive surfaces of water dispersed over the world, which are thus kept pure and made subservient to a healthy state of the atmosphere. It is not only vast, but it is worthy of Him who has appointed to even the meanest of His creatures something to do for the good of His creation."—pp. 31, 32.

For those who, unfortunately, cannot appreciate such views, who might reply that the present supply of oxygen in the air is quite sufficient to last out their time, or even that of the whole human race, and who would ask, "what is the *use* of feeding all these animals?" our author proceeds to enumerate some of the principal uses to which the Algæ have been applied by man, showing that many are directly edible and nourishing, and some prized as delicacies, while others furnish the pasturage of turtles, and are probably needful for the formation of their much prized green fat, the use of which, in feeding the aldermanic race of animals, our objector will probably appreciate. What a pity that the botanist must now leave the famous edible birds' nests out of his list of vegetable esculents, it being lately ascertained that this costly delicacy "consists of an animal substance which is supposed to be disgorged by the swallows that build them." The various other uses to which Algæ have been applied by man, whether civilized or savage, some of them curious, are mentioned at some considerable length.

Another part of the Introduction treats, in a clear and interesting way, of the general structure and morphology of Algæ, tracing the series of vegetable development from the simplest possible vegetable organism, formed of a single cell or vesicle, such as the Protococcus or red-snow plant, which in its growth, or reproduction (for these two functions are reduced to one and the same thing) merely gives rise to other free cells like itself; up to those of considerable complexity of organization and of large or even gigantic size; such as the *Devil's Apron*, *Oar-weeds* and *Murlins* of our own Atlantic shore, and the *Macrocystis*, with "stems from five to several hundred feet in length," the curious *Thalassiophyllum*, and the strange *Nereocystis* of our Northwest coast. The latter "is said, when fully grown, to have a stem measuring 300 feet in length, which bears at its summit a huge air-vessel, six or seven feet long, shaped like a great cask, and ending in a tuft of 40 or 50 forked leaves, each of which is from 30 to 40 feet in length. The cask-like air-vessel buoys up this immense frond, which, like Milton's hero, lies

Prone on the flood extended long and large
(And) floating many a rood.—

Here the Sea Otter (*Lutra marina*) has his favorite lair, resting himself on the vesicle, or hiding among the leaves while he pursues his fishing."—p. 82. On page 86, a fuller account of this wonderful sea-weed is given, translated from the narrative of its discoverer, Dr. Mertens. We wish to call the particular attention of travellers, and of our fellow countrymen of Oregon, to this and to the Thalassiophyllum of the Northwest coast, because they are very imperfectly known; and whoever meets with them, or has occasion to visit the shores where they abound, would confer a great favor and advantage by collecting characteristic specimens of these and also of all other Algæ, immersing smaller specimens in proof spirit or Goadby's solution, and transmitting them to the Smithsonian Institution. These great air-vessels, it appears, cannot be preserved by drying, but probably they might be packed, with their leaves, in strong brine, so as to reach us in good condition.

This leads us to remark that clear directions for collecting and preserving specimens of sea-weeds are given in the Introduction, pp. 28–30. Their *habitat*, or place of growth, and their geographical distribution, especially on our Eastern coast, which Prof. Harvey has explored in person from Halifax to the keys of Florida, are presented with considerable fullness in the Introduction. All these topics are treated in the happiest manner, and so abound with interest that it is needless to indicate particular portions; for it can hardly be that any general reader, still less one with the smallest tincture of science, who opens the Introduction, will lay it down before he has finished it. Still we cannot deny ourselves the privilege of adverting to its appropriate close, in vindication of the moral influence of science, and of the teaching of the book of nature, from the aspersions of the ignorant and the prejudiced.

"Unfortunately, it happens that in the educational course prescribed to our divines, natural history has no place, for which reason many are ignorant of the important bearings which the book of Nature has upon the book of Revelation. They do not consider, apparently, that both are from God—both are His faithful witnesses to mankind. And if this be so, is it reasonable to suppose that either, without the other, can be fully understood? It is only necessary to glance at the absurd commentaries in reference to natural objects which are to be found in too many annotators of the Holy Scriptures, to be convinced of the benefit which the clergy would themselves derive from a more extended study of the works of creation. And to missionaries, especially, a minute familiarity with natural objects must be a powerful assistance in awakening the attention of the savage, who, after his manner, is a close observer, and likely to detect a fallacy in his teacher, should the latter

attempt a practical illustration of his discourse without sufficient knowledge.* This subject is too important for casual discussion, and deserves the careful consideration of those in whose hands the education of the clergy rests. These are not days in which persons who ought to be our guides in matters of doctrine can afford to be behind the rest of the world in knowledge; nor can they safely sneer at the "knowledge that puffeth up," until, like the Apostle, they have sounded its depths and proved its shallowness.

"Why should the study of the physical sciences be supposed to have an evil influence on the mind—a tendency to lead men to doubt every truth which cannot be made the direct subject of analysis or experiment? I can conceive a one-sided scientific education having this tendency. If the mind be propelled altogether in one direction, and that direction lead exclusively to analytical research, it is possible that the other faculties of the individual may become clouded or enfeebled —and then he is the unresisting slave of analysis—not more a rational being than any other monomaniac. And yet, paradoxical though the assertion seem, he may be all his life a reasoner, forming deductions and inductions with the most rigid accuracy, in his beaten track.

"I can conceive too the astronomer, conversant with the immensity of space and its innumerable systems of worlds, so prostrated before the majesty of the material creation, as not only to lose sight of himself and of the whole race to which he belongs, but of the world or even of the solar system, and be led to doubt whether things so poor, and mean, and small can have any value in the sight of the Lord of so wide a dominion. I can conceive him, too, observing the uniformity and the harmony of the laws that govern the whole system of the heavens; the undeviating course of all events among the stars coming round as regularly as the shadow on the dial; and the little evidence there is that this uniformity has ever suffered any disturbance that cannot be accounted for by the law of gravitation, and made the subject of calculation by the mathematician, who, working an equation in his closet, shall come forth and declare the cause of irregularity, though that cause may be acting at thousands of millions of miles distance—I can conceive him inferring from a uniformity like this the absence of a superintending Providence in human affairs. If the Creator, he will say, have given up the very heaven of heavens to the immutable laws of gravitation, can I believe that he interferes by his Providence to superintend the puny matters of this lower world?

"His reasons seem plausible while the mind is pointed in that one direction. But they lose all their force when, laying aside for a moment the telescope, the philosopher investigates with his microscope the structure of any *living* thing, no matter how small and how seemingly simple the organism may be. Let the object examined but have *life*, and it will soon lead him to understand a little of the meaning of God's glorious title, *Maximus in minimis*. And the further he carries his researches, the more the field of research opens, until, extending from the speck beneath his lens, it spreads wider and wider, and at length blends with infinity at the "horizon's limit." Here his boasted

* See some excellent observations on this subject in "Foot-prints of the Creator: or, the Asterolepis of Stromness," by Hugh Miller. London, 1849.

analysis can afford him no help. He has laid bare the "mechanism of the heavens;" he has weighed the sun and the planets; he has foretold with unerring certainty events which shall happen a thousand years after he shall be laid in the dust;—and yet he cannot unravel the mystery that shrouds the seat of life, even as it exists in the meanest thing that crawls. And if the life of this poor worm be thus wonderful, what is that spirit which animates the human frame? What is that humanity which, but a moment ago, seemed like the small dust in the balance compared with the multitude and the masses of the stars? His conceptions of his own true position in the scale of being become more rational. For a moment he views from a new position the distant stars, as the peasant views them in a clear night:—points of light spangling the blue vault above. And he reflects, 'How do I *know* that those shining ones are other than they seem; how do I *know* their size, their distance, the laws by which they are governed; the reins by which the 'coursers of the sun' are held in their appointed track? How?—but by the intellectual powers of that human spirit which but now I deemed so poor and mean:—so unworthy of the very thought of the Almighty—much more so unworthy of the price which He has paid for it.'

"Thus the mind, turned back upon itself, begins to discover that, after all, it is not 'of the earth, earthy,' but derived from a higher source and reserved for a higher destiny. And strange to say, this altered and bettered opinion of itself is traceable to the first check which it feels—the first baffling of its analytical powers. So long as the mind was extending the sphere of its researches into the material universe, weighing, and numbering, and tabulating, all nature seemed to move in blind obedience to a force whose influence might be calculated; every world being found to act upon its fellow in exact proportion to its position and its weight, and *our* world to be but a part, and a small part of one vast machine. And with such a view of the relation of the earth to the universe, might not unnaturally come a lower estimate of man the dweller on the earth. 'Is he too but a part in the house in which he dwells? Is his course also subject to those immutable laws which bind the universe together? And if so, where is his individuality; where the reflex of that image in which he is said to have been created?' But the moment that the mind apprehends the action of the inexplicable laws of life, and is certified of the *individuality* of every living thing however small;—and compares these microscopic 'wholes' with the 'whole' that it feels itself to be, that moment it begins to see that the human soul is a something apart from the world in and over which it is placed."

* * * "Whilst I admit that half views of natural science may lead men astray; and whilst I deplore the infidelity of scientific men, whose minds are absorbed in the material on which they work;—I deny that the study of nature has, in itself, an evil tendency. On the contrary, the study of organic nature, at least ought to be one of the purest sources of intellectual pleasure. It places before us structures the most exquisite in form and delicate in material; the perfect works of Him who is Himself the sum of all perfections: and if our minds are properly balanced, we shall not rest satisfied with a mere knowledge and admiration of these wonderful and manifold works;

but, reading in them the evidence of *their* relation to their Maker, we shall be led on to investigate *our own*.

"I do not assert that this study is, of itself, sufficient to make men religious. But as the contemplation of any great work of art generally excites in us a two-fold admiration—admiration of the work itself, and of the genius of its author—so a true perception of the wonders of nature includes a certain worship of the author of those wonders. Yet we may study natural objects, and admire them, and devote our whole life to elucidate their structure; and after all may fail to recognize the being of Him who has fashioned them. Such blindness is scarcely conceivable to some minds; yet to others, the opposite appears but the effect of a warm imagination. So inexplicable is the human mind! The moral evidence which stirs one man to his centre brings no conviction to another. Physical truths, indeed, cannot be rationally denied; but there is no metaphysical truth which may not be plausibly obscured or explained away by self-satisfied prejudice. Hence the inconclusiveness of all reasoning against infidelity. The failure is not in the reasons set before the mind, but in the non-acknowledgment of the imperative force of moral reasons. No man can be convinced of any *moral* truth against his will; and if the will be corrupt, it is possessed of a blind and deaf spirit, which none can cast out until a 'stronger than he' shall come."—pp. 38–41.

It is to be noted that this is a complete treatise, comprising descriptions of all the species of this country, those of the western as well as of the eastern coast, and from the Arctic shores to Mexico; and that it is our only work on the subject. It is therefore indispensable to all who seek for any information on the subject. To meet, therefore, the demand which there should be for such a work, the Smithsonian Institution, which incurs the whole expense of the publication, has placed this separate issue of a moderate number of copies on sale, with the well known house of Geo. P. Putnam, New York, at a price which barely covers the cost of their production. Copies of this first part bound in cloth sell, we believe, for $3, those in paper covers for $2.50. We trust it will find a ready sale, not only that so admirable work may be widely diffused, but also that the Institution may be encouraged by this first and costly experiment to send forth other treatises and memoirs in the same way, the cost and risk of which is too great for private enterprise to assume. Our only wonder is that the Institution can accomplish so much as it does with its limited and divided resources. But even if its means were much more ample than they are, it is evident that unless it can recover by the sale of separate copies a portion at least of the bare expense of producing them (and especially the expense of striking and coloring plates), such separate copies must cease to be issued in a way that renders them generally accessible, and the edition be nearly restricted to the collected volumes of the *Smithsonian Contributions*. We hope, therefore, that the demand for this History of the Marine Algæ of North America may be commensurate with its merits. A. G.

ART. II.—*On Kirkwood's Analogy;* by J. BRADFORD CHERRIMAN, M.A., Fellow of St. John's Coll., Cambridge, Eng., and Dep. Prof. of Math. and Nat. Phil. in the University of Toronto, U. C.

IN support of the remarks of Prof. Loomis in the American Journal, March, 1851, I beg to offer the following considerations.

The statement of Kirkwood's Analogy is that throughout the Planetary system,

$$n^2 = k \,.\, D^3$$

where n is the ratio of the sidereal period of a planet to its time of rotation about its axis,

D is the diameter of its sphere of attraction,

k is a numerical constant.

It may be observed that this law is not universal, being inapplicable in the case of the outermost planet (Neptune, so far as we know) and also of the Sun regarded as the innermost planet; in the former case, k being made to vanish by D becoming infinitely great; in the latter, by n vanishing. This failure of continuity would entitle us to reject it as a *Law of Nature:* whether it be a *physical fact*, must be examined in detail.

The Analogy breaks, as it ought to do, between Jupiter and Mars, where the asteroids occur, and this deprives us of the means of applying it in the cases of those two planets. The hypothesis of supplying a planet between them does not remove the indeterminateness; for by so doing, we introduce *three* arbitrary quantities, namely, the mass, mean distance, and time of rotation of the supposed planet, and can thus satisfy *any three* required results; in other words, we are able to make Mars, Jupiter, and the supposed planet satisfy *any formula whatever* connecting the quantities, n, k, D.

On applying the Analogy to Mercury, regarding the Sun as the next interior planet, it fails; and if we seek to remedy this by interposing a planet, it remains indeterminate as in the previous case.

On applying it to Uranus, we get a result which is confessedly contradictory to the approximate time of rotation, calculated from the observed compression. The theory of this calculation gives results in accordance with observation in the case of other planets, and there seems to be no reason why we should distrust it in this case. Moreover, the rotation thus given bears on the face of it a trustworthy look, as Prof. Loomis has most ably and strikingly pointed out in the article above quoted. At any rate, the most we can do is to consider the time of rotation unknown, and the *Analogy* in this case also to be indeterminate.

Thus out of the *ten* primary bodies (counting the Asteroids as one) there are no less than *seven*, in which the Analogy is either indeterminate or fails: and we have only *three* left, Venus, the Earth, and Saturn, from which to obtain *two* coincidences that shall establish a law universal in its claims.

The following values are those given in the *Annuaire du Bureau des Longitudes*, for 1851, being the latest authoritative table of whose publication I am aware.

Planet.	Sidereal period in mean solar days.	Mean distance.	Mass in parts of the Sun's.	Rotation.
Mercury,		0·3870985	$\frac{1}{2025810}$	
Venus,	224·70080	0·7233317	$\frac{1}{401847}$	$23^h\ 21^m$
Earth,	365·25637	1·0000000	$\frac{1}{354936}$	$23^h\ 56^m$
Mars,		1·523691	$\frac{1}{2680337}$	
Jupiter,		5·202767	$\frac{1}{1050}$	
Saturn,	10759·2198	9·538850	$\frac{1}{3509}$	$10^h\ 30^m$
Uranus,		19·1824	$\frac{1}{24000}$	

From these I deduce the following table—

Planet.	n	D	k
Venus,	230·9558	·3666685	1082025·
Earth,	366·2738	·5265920	918732·
Saturn,	24592·50	8·513061	980276·

The values of k do not, I think, agree with sufficient nearness to establish the Analogy: in fact, the difference between the values for the Earth and Venus would cause an error of two hours in the rotation of the latter.

Lastly, suppose that a change in density and volume of one of the planets were to take place; then, since the mass and mean distance are unaltered, D remains the same; and since the sidereal period is not affected, it would follow, if the analogy were true, that the time of rotation would remain unchanged, which is contrary to the mechanical principle of the conservation of areas.

From these reasons I feel compelled to reject Kirkwood's Analogy as "the expression of a law of nature," and must agree with Prof. Loomis in considering it *not* established as a "physical fact."

University of Toronto, U. C., April 10, 1852.

ART. III.—*Notes and Observations on the Analyses and Characters of the Soil of the Scioto Valley, Ohio, with some general considerations respecting the subject of Soil Analyses;* by DAVID A. WELLS, Cambridge, Mass.

IN the spring of 1851, I was intrusted by the Secretary of the Ohio State Board of Agriculture, Prof. W. W. Mather, with the office of examining, analyzing and reporting upon the nature and composition of the soils of that State, and under his direction have since made a series of analyses of soils taken from Pike county, Scioto Valley. A few of these analyses are here submitted for the purpose of showing the composition of these fertile soils, as well as to some extent, the method followed in their examination.

The soil which I would first notice, was taken from the best bottom-land, opposite the mouth of Sun-fish Creek, about one hundred yards east of the Scioto. This ground is occasionally overflowed, and has been cleared and cultivated about eighteen years successively in corn, and yields with ordinary culture from seventy to eighty bushels of corn to the acre. The average crop has not sensibly diminished since it was first cleared. The timber growth originally upon this ground, was honey-locust, black-walnut, pawpaw, box-elder, white-ash, elm, mulberry and buckeye.

The color of this soil when dry, was dark brown, or black, of an extraordinary degree of fineness. Sample examined, entirely free from stones or pebbles. The character of this soil for the absorption and retention of moisture was carefully noted, but as the results obtained seem to me to have mainly a comparative value, they are here omitted.

The chemical analysis gave as follows.

Water, hygrometric and combined, . . .		03·636
Waxy and resinous matters extracted by alcohol,	·0030	
" " " " " " ether,	·0025	
Total extract, ...	·0055	
Total per-centage, ...		00·0164

Constituents soluble in pure water.

Extract of earth, alkaline chlorids, with traces of lime,	·0460	
Organic matter—crenic acid, . . .	·0208	
Silica, iron, lime, with traces of sulphuric acid,	·0652	
Total water extract, ...	·1320	
Total per-centage, ...		00·395

Constituents soluble in dilute acid.		
Iron, alumina with traces of manganese, .	01·995	
Organic matter in combination with the above,	01·004	
Silica, ...	00·640	
Phosphoric acid, ...	00·041	
Potash and soda, ...	00·100	
Lime, ...	01·026	
Magnesia, ...	00·236	
Total per-centage of constituents soluble in dilute acid,		5·042
Organic matter rendered soluble by ammonia,		01·840
" " " " " soda,		04·368
Organic matter remaining in combination with the insoluble residue, and determined by ignition,		04·145
Whole amount of organic matter found in the soil, as extracted by water, acids and alkalies, and also determined by ignition from the final residue,		11·373
Whole amount of organic matter determined in another equal portion of the same soil by ignition, .		10·970
Difference, ...		00·403
Insoluble silicates and earthy residue, . .		78·842
One hundred parts of the insoluble residue gave by washing and separation, 45 parts siliceous sand, and 55 clayey matter.		
Total per-centage, of the whole analysis, . .		98·2844

Another soil examined was from the "Ree Ree Bottom," a tract of land occasionally overflowed by the Scioto River. It has been cultivated fifty-one years; forty-five crops of corn and two or three of wheat have been taken off from it; it has also been a few years in grass or clover. It has scarcely diminished fertility and now with the most ordinary culture yields on an average, one year with another, eighty bushels of corn to the acre.

The analysis of this soil gave—

Water, hygroscopic and combined, . .		3·500
Resinous and waxy matters extracted by alcohol and ether, ...		·036
Constituents soluble in pure water.		
Extract of earth, alkaline chlorids, &c. .	·032	
Organic matter—crenic acid, . .	·010	
Iron, lime and silica, . . .	·012	
Total water extract, . . .	·054	
Total per-centage of the same, . . .		0·190
Constituents soluble in dilute acid.		
Iron, alumina and manganese, . . .		2·760
Organic matter combined with the above, .		0·860
Silica, ...		0·560
Lime, ...		0·390

Magnesia,	0·280	
Phosphoric acid,	*traces.*	
Potash and soda,	0·161	
Total acid extract,	5·011	
Organic matter rendered soluble by ammonia,		3·140
" " " " " soda,		1·030
Organic matter remaining in combination with the insoluble residue, and determined by ignition,		1·720
Insoluble silicates,		83·010
100 parts of the insoluble residue gave by washing and separation 59 parts siliceous, and 41 parts clayey matter.		
Total amount of organic matter extracted by alkalies and acids,		6·750
Total per-centage of the whole analysis,		97·637

In the separation of the organic constituents of a soil by means of alkalies, a slight loss is almost unavoidable, owing to the separation and solution of a part of the alumina and other inorganic substances in combination with the organic matter, forming salts.

The third analysis which I present, is that of a subsoil, underlying the fertile loam of the Ree Ree Bottoms. This bottom was originally prairie, at the first settlement of the country. The soil in color is yellow, and in character, coarser than any other variety examined from the Scioto valley.

Chemical analysis gave as follows:

Water, hygroscopic and combined,	00·44	
No appreciable matter extracted by either alcohol, or ether.		
Constituents soluble in pure water.		
Alkaline chlorids,	·0070	
Organic matter, with traces of silica and lime,	·0055	
Total water extract,	·0125	
Total per-centage,		00·057
Constituents soluble in dilute acid.		
Iron, alumina and manganese,		02·000
Organic matter, combined with the above,		00·440
Silica,		00·200
Lime,		02·550
Magnesia,		01·280
Phosphoric acid and alkalies,		*traces.*
Total per-centage of constituents soluble in acid,		6·470
Carbonic acid,		02·300
Organic matter rendered soluble by ammonia,		00·42
" " " " soda,		00·05
Organic matter remaining in combination with the insoluble residue, and determined by ignition,		00·50
Insoluble silicates, &c.,		90·270
Total per-centage of the analysis,		100·507

In the examination and analysis of these soils of the Scioto Valley, several points of interest were noted by me, which I consider worthy of especial attention. Their reputation for fertility is extensively known, as well as their general character and chemical composition, but I am not aware that any extended and thorough examination of a suite of specimens, from known localities, has heretofore been made by any chemist.

The first and perhaps the most interesting fact noticed in the examination of these soils was the remarkable degree of fineness of their constituent particles. In this respect I venture to assert that they are not surpassed by any other alluvial deposits upon the surface of the earth, some of the soils being little else than impalpable powders. In commencing their examination, it was at once seen, that a mechanical division of these soils by means of the sieves ordinarily used in soil analyses, would not afford a fair indication of the minuteness of their particles. I therefore procured a sieve of the finest gauze, the largest meshes of which by accurate measurement did not exceed one-sixtieth of an inch in diameter. The soil was then broken in a porcelain mortar, care being taken that only the dried particles were crushed, without triturating any of the silicates or earthy matter. One hundred parts of six samples so treated, were sifted upon the sieve before described, and left the following small quantities of coarse residue; of this residue, it should be stated, that it was composed in part of vegetable fibres and undecomposed organic matter. Of soil No. 1, seven parts in one hundred remained upon the sieve; of No. 2, one and six-tenths parts; of No. 3, a subsoil, from twenty to thirty parts; of No. 4, six and three-tenths; of No. 5, one and five-tenths; of No. 6, eight parts in one hundred.

This remarkable comminution of the particles of these soils, gives us at once a clue to the secret of their great fertility. With this fineness an increased power is given to a soil for the absorption, retention and condensation of moisture, carbonic acid, and ammonia, an opportunity for the free permeation of atmospheric air, a facility to the rootlets of plants for extension, and a consequently increased facility for receiving and appropriating nourishment. Indeed, a soil but scantily provided with the inorganic constituents deemed necessary for the support of vegetable life, but gifted with this fineness of the elementary particles, must possess great elements of fertility. I consider the existence of a large proportion of finely divided matter in a soil, of almost as much consequence so far as regards its fertility, as its chemical constitution is. It must be also evident, that a soil composed in great part of siliceous matter (as many of the fertile western soils are), may, if the particles possess sufficient fineness, assume to a considerable extent the good properties and characteristics of an aluminous soil, without its bad ones. As an illustration of this I

would state, that one of the best tobacco soils upon the Island of Cuba, some time since examined by Dr. A. A. Hayes of Boston, was found to contain ninety per cent. of the peroxyd of iron. And yet this soil, which we might suppose would be barren, without the usual proportions of siliceous and aluminous matter, is, on account of its great fineness, and the remaining ten per cent. of organic and inorganic constituents, enabled to produce the best crops upon the island.

These advantages of fineness, it is evident the Ohio soils will always possess, as it cannot be exhausted by any system of agriculture. To this point I wish to call especial attention, since if due regard be paid to the supplying of these soils with the necessary quantities of organic and inorganic nutriment, they must and always will be unrivalled for fertility. An examination of the silicious insoluble constituents of these soils, leads to the belief, that they have not been derived from the disintegration, or decay of any underlying or contiguous rocks, but from materials brought from a distance. The rocks of Ohio are for the most part carbonate of lime, and yet in only one of the soils examined, a subsoil, could the slightest trace of carbonic acid be detected. The method adopted for testing, was by placing the soil in a favorable light upon a watch-glass, covering with dilute warm acid, and noticing carefully for the appearance of effervescence. In this way the most minute quantity of carbonic acid could not fail of being detected. In the examination of the soils of Massachusetts by Pres. Hitchcock, the same remarkable deficiency of carbonates, even in soils resting upon carbonate of lime rocks, was noticed. The same conclusions have, I understand, been arrived at by Dr. D. D. Owen, from an examination of the soils of Iowa and Wisconsin. From these facts we believe that the alkaline and earthy carbonates are to a much greater extent wanting in arable soils than is generally supposed. This supposition, however, should perhaps be confined to the northern portions of this country, which have soils resulting mainly from materials distributed by the drift agency.

When a soil containing considerable quantities of organic matter is tested for carbonates after ignition, they will generally be found, the crenates and apocrenates passing over into carbonates, and remaining fixed except at a high temperature.

A microscopic examination of the siliceous insoluble residues of these soils, left after the extraction of all soluble organic and inorganic substances, showed that they are composed of the detritus of syenitic and porphyritic rocks, consisting of minute particles of quartz, feldspar and yellow jasper without the presence of mica. I would not, however, present these facts as wholly conclusive respecting the origin of these soils; the quartz, jasper and feldspar may have had their immediate origin in the Waverly

and other sandstones of Ohio, and the carbonates may have disappeared by the action of vegetation and long continued washing and filtration. But the impression left after a careful examination of their constituents was, that the soils of this portion of Ohio, have had an origin similar to that of other soils which are known to have resulted from drift agency, and possess at present a character, different from what might have been expected had they resulted from the decomposition of underlying or contiguous rocks.

The quantity of organic matter in these soils, is generally large, ranging from two to eleven per cent. in the specimens examined. It should be stated that the estimation of this organic matter was made upon the finest portion of the soil after sifting, and in this there is not included the smallest portion of undecomposed vegetable fibre, which is not unfrequently included in the organic per-centage of other analyses. The amount of nitrogenous compounds contained in this organic matter is undoubtedly large, although not determined; the peculiar odor of these products while burning being very appreciable.

Particular attention was given to the accurate determination of the amount of waxy and resinous matters contained in these soils, and although it may not be possible to say that they enter unaltered and directly into vegetable systems, yet we know that as constituents of vegetables they re-enter to form fats in the systems of animals, I can, therefore, but consider a soil analysis, into which their careful determination is not included, as essentially deficient. In the statement of the analyses, the products extracted by alcohol and ether are given separately. At present I am not prepared to say, that bodies of a different constitution are extracted by these different solvents. There are, however, reasons which induce me to believe this is really the case, and also that the products so extracted are not mere resins and gums, as is generally supposed, but vegetable fat acids. This important point which a want of time has compelled me in great measure to overlook, will form the subject of future investigations. I would also say that this matter has engaged the attention of Dr. A. A. Hayes, of Boston, who fully coincides with me in the opinions expressed.

Among the constituents of these soils soluble in water, were found soluble organic matter (to which Berzelius has applied the term "extract of earth, or mould," and Dr. Dana of Lowell, "solution of vegetable extract,") alkaline chlorids, lime, magnesia, iron, silica, and organic matter combined with these bases. The presence of the first three of these bodies was to be expected; but the solution of the last three in water, in the absence of a mineral acid, and that too in considerable quantities, is, it seems to me, especially worthy of notice. An explanation must

be sought for in the presence of organic matter, crenic, or apocrenic acid. In the later published works of Mulder, a salt of $C_{48}H_{12}O_{24}$ (apocrenic acid) $+NH_4+KO+CaO+MgO+FeO$, is given as soluble in water. It is not improbable that the extractive matter noticed, may have possessed this constitution. In all the soils examined, appreciable quantities of alkalies and phosphoric acid existed.

In these analyses, for the first time, has the amount of organic matter combined with the iron and alumina been carefully estimated by itself. This organic matter is undoubtedly combined with the above mentioned bases as an acid, and as such may have an important bearing upon the fertility of a soil. In some of the New England soils, this acid has been ascertained by Dr. Hayes of Boston to be oxalic acid, and such localities as might be expected, were adapted to the growth of sorrels and other acid plants. I have tested the soils examined by me from Ohio carefully for oxalates, but have not been able to detect them. What other acid may be present I am unable to say: the subject in this connection is new and requires careful investigation.

Manganese was present in all the soils examined. Its quantitative determination, unless present in large quantities, as well as the separate estimation of the amount of iron, and the amount of alumina, soluble in acid, I consider of little or no value in a soil analyses. Manganese appears to be a constituent in small quantities in almost all soils, and in the waters of lakes, ponds, and rivers, and must undoubtedly rank among the elementary bodies most widely distributed.

In the analyses of these soils, the separation, and estimation of the comparative value of the organic constituents has been made by means of alkalies. This plan seems to possess advantages over that of any other. A given portion of the soil, after washing with water and dilute acid, is digested with a small quantity of caustic ammonia. The organic matter rendered soluble is washed out, precipitated by an acid, dried at 250° F., and weighed. This determination it is considered shows at once the *present value* of the organic portion of the soil—in other words, how much organic matter is so far decomposed, or changed, as to be available for the present crop. The soil after digesting with ammonia and washing, is next treated with a stronger alkali, caustic soda, and the organic matter rendered soluble by this agent is collected and determined as before. This estimation, it is conceived, shows the amount of organic matter existing in a state not so sufficiently decomposed, or changed as to be immediately available for the use or nourishment of plants, but in a state preparatory for such use, or nourishment, and which at no distant period will become available. Thus if we were to represent the

organic matter rendered soluble by ammonia as in the state of crenic acid, ready to be dissolved in water, or by the aid of weak alkalies, we might consider the organic matter rendered soluble by soda, as in a state of apocrenic or humic acid, insoluble in water or weak alkalies. Lastly, it is found that after digesting a soil even with strong alkalies, and after repeated washings with acids and water, a considerable quantity of organic matter will remain fixed, and completely insoluble. This portion of organic matter, generally the largest in a soil, is considered to be in a state allied to charcoal, or more properly lignite, valuable in many respects, as an absorbent of moisture, etc., but taking no active part in the production and sustinence of the plant. In ordinary soil analyses, the amount of organic matter, in these three conditions is determined as a whole, and without distinction, thus giving the agriculturalist no opportunity of judging whether this portion of his soil is in a condition resembling a peat bog, or in a state conducive to fertility.

There is one other subject connected with these analyses, which I consider of the highest importance, and to which I would direct especial attention. Dr. Dana of Lowell, in the course of many years experience, has collected and preserved the results of more than four hundred analyses of soils, from the northern portion of this country. The analyses of the soils I have made from Ohio, and the analysis of all the soils resulting from the drift agency, do not differ *materially*, so far as regards their inorganic constituents. That is to say, the soils of Ohio, yielding with little or no culture from seventy to eighty bushels of corn to the acre, are no better so far as their mineral composition is concerned, than many of the Massachusetts soils which have a reputation for sterility. Slight differences it is true, exist, but not to such an extent as might be supposed from contrasting their relative products of the different soils. In what then is there a reason for their difference in value to be found? It cannot be in the attributes in which they agree—which are their mineral constituents, but in the attributes in which they differ; and these are the amount and condition of the organic matter contained in the soils, and the fineness of their elementary particles.

These conclusions, if of any value, may show to the agriculturalists of New England, the necessity for the thorough breaking and pulverizing of the earthy particles, and for the preservation, preparation, and proper application of organic manures, the produce of the farm-yard and the muck-beds. These suggestions are not new; they are the results of the experience of ages, and of the observations and experiments of every practical farmer. The agricultural tendency of the present day is toward mineral manures;—I would not undervalue them, but at the same time I wish that the old notions respecting thorough tillage, and the

value of barn-yard products, notions, the value of which experience has taught, and which all scientific investigations are now confirming, may not be underrated, or undervalued.

There is another topic in this connection to which I may be permitted to allude, as it deeply concerns the prosperity of scientific agriculture in this country—and that is, the tariff of prices paid for soil analyses. My own opinion, and the opinion of of others who are most conversant with this subject is, that a complete and thorough soil analysis cannot be made with any profit to the analyst for a less sum than twenty dollars. Yet the usual price charged is about one-fourth this sum, and in a comparatively recent instance, the editor of an agricultural paper in one of the northern states, has publicly offered to make complete and thorough soil analyses for the sum of two dollars. Such a proposition should stamp its author at once as a charlatan and a quack. It is time that this subject was rightly understood by the agricultural community, as it is not improbable that much of the ill-success and ridicule which has attended the application of science in this direction, is owing to analyses and other similar investigations which have been made and *fully paid for* according to the above mentioned rates. My excuse for introducing this subject, will I trust be found in its importance.

ART. IV.—*On the Chemical Principles involved in the Manufactures of the Great Exhibition;* by LYON PLAYFAIR, C.B., F.R.S.*

THE industrial products of the different countries represented at the Exhibition showed, as a marked feature of ascending civilization, that civilized states differ from barbarous nations in their manner of employing natural forces as aids to production. In the less advanced state, human labor, often exhibited with an endurance and patience scarcely conceivable to Europeans, attained good results, though not superior to those produced by European methods involving quick execution with little manual labor. I might refer you, as an example, to the fine blue glazed tobes worn by the higher class of Africans. This cloth, dyed with indigo, receives its gloss by the laborious process of rubbing with the shell of a snail as hard as the force of the wrist can bear. About fifty years since, our handloom weavers used a round bottle for a similar purpose, but now our calenderers give, in the same time, to miles of cloth a gloss superior to that produced by

* From the Lectures on the results of the Exhibition, delivered before the Society of Arts, Manufactures and Commerce, at the suggestion of H. R. H. Prince Albert, President of the Society.

this infinitely laborious process to a few inches of the material. It would appear that the less civilized nations attain a high degree of excellence in manufactures when they depend on mere ingenuity and labor, as in the muslins of Dacca and Chunderee, and do not involve an intimate acquaintance with natural forces. So far as regards beauty of design and the harmony of colors, European nations had little to teach, but much to learn. The rude pottery of Tunis was more elegant in form than the common pottery of modern Europe. The shawls and carpets of India, both as to design and harmony of coloring, were unequalled. So long as the manufactures involved human labor and a perception of beauty as their principal elements, the less civilized states equalled, and often excelled the productions of Europe. But when economy of time and of labor, or an enlightened comprehension of a natural force, became essential conditions, then the striking progress of European manufactures was manifested.

The progress of civilization, with its necessary increase of human wants, compelled man to invent means for their gratification. The study of natural forces then became necessary, because their employment not only added much to his power, but also materially economized his time. The cleansing of the Augean stables by manual labor was impossible even to the enduring powers of Hercules; but by the use of a natural force, in the form of the waters of the Alpheus, the work was speedily and effectually accomplished.

The position of nations in the scale of civilization depends upon their greater or less acquaintance with, and employment of, natural forces. All nations have a conception of their use, but their relative success arises from their applying them to the best advantage and under the most favorable circumstances. In the attempt to storm the fort of Arcot, the Rajah drove before him numerous elephants, armed with iron plates, in the hope that the gates would yield to these living battering-rams. But the gallant Clive met this ill-applied, by a well-applied, force. The eighth of an ounce of gunpowder, propelling an ounce of lead from an iron tube, was sufficient to alter the direction of this misused force, and to cause the huge beasts to turn and trample upon the army using them as allies.

Mechanics being a deductive science, and naturally growing from the observation of common phenomena, afforded powers which man availed himself of in an early state. The separate action of two mechanical forces being known, the result of their combined action can be predicated. But in chemistry it is very different. Two bodies, such as muriatic acid gas and ammoniacal gas being brought together, no previous reasoning could tell us that from these two gases a solid would be produced; and nothing inherent in themselves could enable us to say, that the

acid character of the one and the alkaline character of the other would wholly disappear in the resultant. Chemistry, therefore, in its present state, as Mills has shown, is not so much a *deductive* as an *experimental* science. Before it could be applied to the purposes of Industry, its experience had to accumulate, and its teachings to be appreciated and systematized. This accumulation of experience has been going on from the time of Tubal-Cain until now, and every day, in adding new facts to the stores, materially augments its powers. It is not, therefore, surprising that it is one of the last of the sciences which, as a branch of systematized knowledge, has offered its services to man; yet, during its short existence as a separate science, it has increased human resources and enjoyments to a greater degree than any of its elder sisters. If I can show you this by proofs derived from the Exhibition, it will naturally follow, that the study of Chemistry is essential to those engaged in manufacturing industry.

The wants of civilization and the effects of competition require the effective application of increased power, both with regard to economy of labor and of time; and, in the gratification of these wants, there is a constant aim to render objects apparently of little value useful and productive. These, the benefits conferred upon industry by mechanical science, as shown by Babbage and others, are also afforded still more strikingly by her younger sister, Chemistry. Examining the various applications of Chemical Science to manufactures, they naturally divide themselves into the following three heads, which I therefore adopt as the basis of my Lecture.

1. Chemical appliances which have added to human power, either by furnishing substitutes for mechanical contrivances, or by affording tools and methods of arriving at results formerly impossible.

2. Methods of producing economy of time, generally resulting from a constant tendency to simplification.

3. Methods of utilizing products apparently worthless, or of endowing bodies with properties which render them of increased value to industry.

When a manufacture is already established, the results of competition not only compel an increasing attention to the economy of power or of time, but also require an increase of the industrial value of the article offered for competition. He that can replace an expensive mechanical power by a cheap chemical process, or can economize production by the happy adaptation of natural forces, must possess advantages over his less skillful competitors. Vulcan produced his works more economically than the mere mortal blacksmiths of his time, by availing himself of the fires of Mount Etna for his forges. The possibility to do what pre-

viously could not be done generally effects a moral as well as a physical result. The communication of a new power often occasions great social changes. It has been justly said, that the discovery of the Greek fire projected from the walls of Constantinople "saved Europe from desolation by the Saracens;" and it is equally true, that the personal animosity of warriors and the hostile spirit of nations have been much subdued by the new system of tactics introduced when a German monk, in deflagrating a mixture of sulphur, nitre, and charcoal, discovered gunpowder. Morality was improved and crime lessened, when the brilliant lighting of our streets by the introduction of gas made every passer-by a detective policeman; just as the cares, anxieties, and expenses of a government, will be diminished by a fuller development of the electric telegraph.

In addition to the direct communication of power, the increased economy of time resulting from chemical appliances is of immense importance in manufactures. This sometimes follows the discovery of new bodies endowed with peculiar properties, but it far more commonly arises from the reduction of a complex to a simple process. It is with chemistry as with mechanics: the progress of discovery is in the direction of simplification. The simplification of complex processes is the economy of labor, the husbanding of wealth. Industry, in its progress, continually finds more ready means of cultivating and reaping fields long in its possession. You all recollect the story of poor Ho-ti and the pig, told with such delightful vivacity by Charles Lamb. When Ho-ti's house, containing a litter of young pigs, was burned to the ground, it was natural that he should discover the delicate taste of roasted pig; and it was equally natural, as a consequence of this discovery, that the inhabitants of Pekin should introduce pigs into their houses, and burn them down, when they desired to participate in a dish so savory: but it was a great discovery when an ingenious person found that a common fire would do equally well, and that it was not absolutely necessary to burn down a house every time a pig had to be dressed. "By such slow degrees," concludes the Chinese History, "do the most useful and seemingly the most obvious arts make their way among mankind." The moral of this well-known story is of every day occurrence in the chemistry of the arts. Not a year passes without the most mature processes of manufacture being further simplified and economized. It is with industry as with nature; many of the lower animals have a repetition of organs, destined for the performance of similar functions exercised by single organs in the higher animals. Various stomachs and several eyes in the lower creatures are not more effective than one stomach and two eyes in man. The law of repetition of organs is like the complex processes of manufactures, represented by

fewer but more perfect methods as civilization ascends. Argus, with his hundred eyes, was not nearly such a practical man as a Cyclops with one eye; the hundred eyes of Argus were found napping when work had to be performed, but with the one eye of the Cyclops the trident was forged which assured to Neptune the empire of the sea. The industrial position of England has been gained by her perception of this truth, and by her constant endeavors to replace complex processes of manufacture by means more simple and perfect.

The third division, into which I have divided chemical appliances to industry, is one peculiarly characteristic of advancing civilization. European nations, as they increase in wants, examine every material, to see if it be adapted to their ministration; they do not, like the African Dokos, bury their heads in the ground, and shaking their legs in the air, thank the Supreme Being that they are content with snakes, ants, and mice, for their food. Using their heads for sublimer purposes, they observe and investigate the phenomena and properties of each body, so as to ascertain how far it may be made subservient to their desires. In these investigations chemistry offers vital aid: she like a prudent housewife, economizes every scrap. The horseshoe nails, dropped in the streets during the daily traffic, are carefully collected by her, and reappear in the form of swords and guns. The clippings of the travelling tinker are mixed with the parings of horses' hoofs from the smithy, or the cast-off woolen garments of the poorest inhabitants of a sister isle, and soon afterwards, in the form of dyes of brightest blue, grace the dress of courtly dames. The main ingredient of the ink with which I now write was possibly once part of the broken hoop of an old beer-barrel. The bones of dead animals yield the chief constituent of lucifer matches. The dregs of port-wine, carefully rejected by the port-wine drinker in decanting his favorite beverage, are taken by him in the morning in the form of Seidlitz powders, to remove the effects of his debauch. The offal of the streets and the washings of coal-gas reappear carefully preserved in the lady's smelling-bottle, or are used by her to flavor blancmanges for her friends. This economy of the Chemistry of Art is only in imitation of what we observe in the Chemistry of Nature. Animals live and die; their dead bodies, passing into putridity, escape into the atmosphere, whence plants again mould them into forms of organic life; and these plants, actually consisting of a past generation of ancestors, form our present food.

The objects of the Exhibition were divided into—1. Their raw materials; 2. The machinery used in their preparation; 3. The manufactures themselves; 4. The fine art employed to adorn them. I would that I had time to take even a general

chemical survey of these four divisions, and show you how everywhere chemistry is affording her aid; but as this is impossible, I must content myself with isolated examples from the manufacturing department only, adducing them, however, merely as indications of the universal presence of the science.

Iron Smelting.—Let us select the smelting of iron* as an example of the teachings of Chemistry. If practice, unaided by science, be sufficient for the prosecution of manufactures, this venerable art must be thoroughly matured, and science could scarcely expect to be of much use to it in its present state. But while we find much to admire in the triumphs of practical experience, there is yet great room for the improvement of this art. The cheapness of iron ore, and of the coal used in its smelting, has been so great, that, regardless of their capital importance to this country, we, like careless spendthrifts, use them without thought of the future.

The mode of smelting iron consists in mixing the ore with lime and coal, the former producing a slag or glass with the impurities of the ore, while the coal reduces the oxyd of iron to its metallic state. Much heat is required in the process of smelting, but the cold air blown in, as the blast, lowers the temperature, and compels the addition of fuel, as a compensation for this reduction. Science pointed to this loss, and now the air is heated before being introduced to the furnace. The quantity of coal is wonderfully economized by this application of science; for instead of seven tons of coal per ton of iron, three tons now suffice, and the amount produced in the same time is increased nearly sixty per cent. Assuredly this was a great step in advance. Could science do more?

Professor Bünsen, in an inquiry in which I was glad to afford him aid, has shown that she can. We examined the furnaces, in each portion of the burning mass, so as fully to expose the operations in every part of the blazing structure. This seemingly impossible dissection was accomplished by the simplest means; the furnaces are charged from the top, and the materials gradually descend to the bottom; with the upper charge a long graduated tube was allowed to descend, and the gases streaming from ascertained depths were collected and analyzed. Their composition betrayed with perfect accuracy the nature of the actions at each portion of the furnace, and the astonishing fact was elicited, that, in spite of the saving produced by the introduction of the hot blast, no less than 81½ per cent. of fuel is actually lost, only 18½ per cent. being realized. If, in round num-

* Although the smelting of iron is not strictly within the division of manufactures, according to the classification, its importance to this country will authorize an exception in its favor.

bers, we suppose that four-fifths of the fuel be thus wasted, no less than 5,400,000 tons are every year thrown uselessly into the atmosphere, this being nearly one-seventh of the whole coal annually raised in the United Kingdom. This enormous amount of fuel escapes in the form of combustible gases, capable of being collected and economized; yet in spite of these well ascertained facts, there are scarcely half a dozen furnaces in the United Kingdom where this economy is realized by the utilization of the waste gases of the furnace.

Large quantities of ammonia are annually lost in iron smelting, which might readily be collected. Ammonia is constantly increasing in value, and each furnace produces and wastes at the least 1 cwt. of its principal salt daily, equivalent to a considerable money loss. With the low price of iron, this subsidiary product is worthy of attention. As I write, a Welsh smelter has visited me, to say that he has adopted this suggestion with advantageous results. I might adduce other improvements introduced by chemistry in the smelting process; but these will suffice to show you that she has added to human power by increasing production, while she has also economized both the time and the materials employed.

Textile Fabrics.—Without the aid of chemistry, it would have been impossible for textile fabrics to have attained their present developement. The bleaching of cotton and linen was not much practised in England until about a century since: before that time, they were sent to Holland, where the operation of bleaching consisted in steeping them in potash for a few days, afterwards for a week in buttermilk, and then exposing them for several months on a meadow to the influence of the sun and moisture. A great improvement was made in Scotland, by substituting sulphuric acid for sour milk; and the immediate effect was, to reduce the time from eight to four months. In 1785, a French chemist suggested the use of chlorine as a means of hastening the process, and, in the last year of the eighteenth century, a compound of this gas with lime was introduced by Tennant of Glasgow. The development of the cotton manufacture now became immense. By a happy adaptation of other chemical processes, in conjunction with the bleaching power of chlorine, the time required for the whitening of cotton and linen fabrics was at once reduced from months to hours, while the miles of outstretched calico, defacing the verdure of country districts, disappeared, the whole operation being carried on within the small space of an ordinary factory. You may imagine what an impulse this gave to a trade so important to us. The bleaching of calico now consists of a chemical operation of great precision; that of silk and wool has not yet been so thor-

oughly comprehended by science, and consequently has not derived so many advantages from its application.

A greater acquaintance with the theory of bleaching has led to a better understanding of the very ancient practice of washing. The washing of domestic linen is by no means an operation too insignificant for the attention of the chemist. A dozen shirts may cost 3*l.* 12*s.*, this being the united interest of the producer, cotton-spinner, and shirt-maker. These shirts will last three years, with care, and supposing three to be washed each week, the cost of washing—that is, the washerwomen's interest in the dozen shirts—amounts to 7*l.* 16*s.*, or more than double that of the cotton-spinner. In fact, the cost of washing is about one-twelfth the income of a family of moderate means. Taking rich and poor together, and estimating the cost of washing at no more than 3*d.* per head weekly, the annual charge of washing to the metropolis alone is 1,535,060*l.*, which is equal to about one-twenty-fifth of the whole capital invested in the cotton manufactures of the United Kingdom. Hard water usually contains lime, and in washing that earth unites with the fatty acid of soap, producing an insoluble body of no use as a detergent. For every 100 gallons of Thames water, 30 oz. of soap are thus wasted, before a detergent lather is formed. In personal ablution, we economize this excessive waste by the uncomfortable practice, universally followed in London, of taking about an ounce of water into the hands, and converting it into a lather, the water in the basin being only employed to rinse this off, instead of aiding in the detergence. But in washing linen this plan cannot be followed, every particle of the lime being removed before the soap becomes useful; this, as a matter of economy, is frequently accomplished by carbonate of soda, as being cheaper than soap. The amount of soap and soda salt thus wasted in the metropolis has been stated to be equal to the gross water rental. Hard water, besides wasting soap, produces a great tear and wear of clothes.

All these facts are well known to manufacturers, and hence the care with which a water is selected before the seat of a manufactory is determined. Why, then, should we not attend to our domestic manufactures, considered trifling only because they are carried on with a great division of labor, unseen in its aggregate? Yet these domestic manufactures are of more importance, economically, than those carried on in large and imposing factories.

I wish I had time to refer, with sufficient detail, to the discovery of Mercer, who has shown that the immersion of cotton in soda or in sulphuric acid causes an equal contraction of the fibres, thus producing the mechanical effect of a loom. If very fine calico, containing as much as 180 picks to the inch, be thus

treated, it contracts to calico of 260 picks to the inch—a fineness not yet attained by any mechanical contrivance. This calico, in addition to its acquired fineness, has also assumed powers which enable it to receive colors superior to those assumed by ordinary calico. Before leaving this important discovery of Mercer, I should allude to one other by the same chemist. The French calico-printers employ mousselines-de-laine consisting altogether of wool, while in England we use a much cheaper fabric, consisting of wool and cotton. The colors of this mixture are, however, extremely meagre when compared with the former; but Mercer has shown that the mixed fabric acquires the properties of the other, when it is treated with a bath of chlorid of lime. This, one of the most important discoveries ever made in calico-printing, has been of great value to this country.

I cannot, however, allude to all the triumphs of chemistry in calico-printing, an art which has grown with the growth of chemistry and strengthened with its strength. The knowledge of mordants and of colors, and the other results of chemical discoveries, are of every-day occurrence. Let us take one of the last examples. Lapis lazuli, long celebrated for its beautiful blue, almost ranked among the precious stones, and was sold at a price which put it quite out of the reach of the calico-printer. But chemists, ascertaining its composition by analysis, soon learned how to make it by synthesis. Artificial ultramarine is now manufactured at three or four shillings per pound. But when it was made, how was it to be fixed on cloth? From its insolubility, its fixation was a real difficulty. Chemists suggested that the ultramarine might be mixed with albumen, which, being coagulated by heat, would retain the color on the cloth to which it was applied. Whole barrels of the dried white of eggs are now to be seen at calico-print works. Yet this is an expensive process. Could common cheese not be substituted for the white of eggs? Cheese is soluble in ammonia, and the ultramarine, being mixed with this solution, is retained by the cheese, when the ammonia evaporates. Now, therefore, the ultramarine is fastened on by cheese, made from the buttermilk of Scotland, and sold under the name of lactarine.

A recent application of chemistry to the economy of dyeing deserves especial attention. Madder, the dye most commonly used for calico, after imparting its color, was considered useless. The large quantities of spent madder constantly accumulating were found exceedingly inconvenient. It was not valuable enough for the manure-heap, and the rivers became polluted in carrying away the waste material. But chemistry has shown that actually one-third of the coloring matter is thus thrown away, and that simple treatment with a hot acid again renders it available as a dye. These waste-heaps are now sources of wealth,

and the dyer no longer poisons the rivers with spent madder, but carefully collects it, in order that the chemist may make it again fit for his use.

Stannate of soda is a salt largely used by calico-printers. The usual mode of preparing it was, (1), tin was reduced from its ore; (2), this tin was dissolved in muriatic acid; (3), it was oxydized by nitric acid or chlorine; (4), the oxyd thus formed was precipitated and redissolved by soda, this bulky, aqueous solution being furnished to calico-printers. Mercer simplified the process, and obtained it in the solid state by two operations: (1), the tin was obtained as before; (2), this tin was fused with a mixture of nitrate of soda and caustic soda, the former oxydizing it, and the latter forming stannate of soda with the oxyd thus formed. Young showed in the Exhibition a still further simplification. The common ore of tin is an oxyd: why, then, was it necessary to reduce it to the metallic state merely to oxydize it again? He therefore fused the ore at once with soda, the impurities remaining undissolved; and the salt was made by one operation. I quote this instance as a remarkable example of the tendency of Chemistry to simplify processes of manufacture. The history of this salt is an exact parallel to that of Ho-ti and the pig.

I might refer to the important discoveries of yellow and red prussiate of potash, the formers of Prussian blue; but this would only be to cite one out of innumerable appliances. I prefer, therefore, to finish this part of the subject, by alluding to the resists and discharges used in calico-printing. In order to preserve white patterns in the process of dyeing, the nations of the East, whence calico-printing originated, still employ the most laborious mechanical devices, each white spot being covered with sealing-wax, or by being tied up and protected from the dye. By the aid of chemistry, we either discharge the color on the cloth, or we put upon it bodies which resist the action of the mordants and prevent the color attaching to that particular part. Acids made from the lees of wine (tartaric acid) and from the lemon (citric acid) are now largely used in these operations, and hence come the beautiful paterns we enjoy in our dresses. It was found that, even when the whites were thus obtained, they became soiled in washing off the excess of mordants from the other parts of the cloth; and the only mode of preventing this was, to treat the cloth with a bath of cowdung. Large dairies were consequently necessary adjuncts of a calico-print work. Chemistry has shown that the action of the manure is due to its phosphates; and a mixture of phosphate of soda, phosphate of lime, and size, is now substituted for the filthy baths formerly indispensable. I could spend hours in discoursing to you on the triumphs of Chemistry in the dyeing of textile fabrics, whether of cotton, wool, and silk, or their mixtures; but I must content

myself with these few isolated examples, and pass on to other subjects.

Leather.—The manufacture of leather has been less advanced by the application of Chemical Science than any other of the arts. If Simon, the tanner of Joppa, had been able to send leather to the Exhibition, no doubt he would have carried off a medal for leather as good, and made exactly by the same process, as that of our most eminent manufacturers of the present day. And yet the science of leather production is better understood now than then; but so many physical conditions are involved in the production of good leather, that scientific processes have been unable to satisfy them all. The hides, steeped in an infusion of oak-bark, absorb tannin and are converted into leather. Good sole leather takes about a year to tan, and even calf-skins consume a month in the operation. Chemists have certainly indicated substitutes for bark, containing a greater amount of tannin, and these, as for instance terra japonica, cutch, catechu, and dividivi, produce their effects in half the time; but the leather is said not to be so durable. With sumach, light skins may be tanned in twenty-four hours, and with the aid of alum even in one hour; but the resulting manufactures are not preferred to the old processes. Atmospheric and hydrostatic pressure have been used to hasten the absorption; the refined laws of Endosmosis and Exosmosis have been called in to accelerate the process; heavy rollers have squeezed the solution through the pores; but all these methods have had at the best but a doubtful success. Leather-manufacturers meet men of science by the well-founded assertion, that the resulting leather is too porous, too hard or too soft, or not sufficiently durable; and they revert to their old traditional modes of preparation. I allude to these failures the more especially to show that there is a wide chasm between the chemist's laboratory and the workshop,—a chasm which has to be bridged over by the united aid of the philosopher and the manufacturer. One without the other does not suffice, but both, working together, may achieve great results. Yet, in bridging over this chasm, they must act on a common plan. If the manufacturer build his half without understanding the principles of construction employed by the other, the sides of the bridge may indeed meet, but they are not constructed to receive the binding influence of the key-stone, and the arch must give way and tumble down.

Having thus shown the comparative failure of chemistry in revolutionizing this important manufacture, let me take one or two instances from it to prove that, in the details of the working, it has been of use in economizing time and labor, and in affording new uses to comparatively valueless objects. In removing the hair from the hides, previous to tanning, it was customary to

shave it with a knife. This process was tedious and imperfect, and the following simple one is now used. Lime-water dissolves the bulbous root of the hair, when the hides are immersed in it for some time, and the hair may then be readily removed by a blunt instrument. By this simple process one man can remove the hair from a hundred kid-skins in about an hour. Still the immersion requires several weeks, while the addition of red orpiment to the lime, as practised by the sheep-skin manufacturers of France, reduces the time to a few hours.

When goat-skins are tanned for morocco leather, it is necessary, in order to adapt them for dyeing, to remove the lime absorbed by the last operation. A solution of *album græcum* cleanses the pores effectually, leaving them so spongelike, that air can readily be forced through them. Hence the process of tanning is rendered much easier, being in fact completed within twenty-four hours; while the leather is rendered fit to assume the colors so characteristic of morocco. About fifty persons are employed in London to collect the sweepings of dog-kennels for this purpose, and many more in applying them; and I am informed, by Mr. Bevington, that the sum annually paid to the collectors and workmen employed in using this apparently worthless substance, is not less than 5000*l.* in the metropolis alone.

The currier shaves leather to render it of equal thickness, and the shavings are treated as waste, scarcely fit for the manure-heap, but chemistry has shown that they contain much nitrogen, which renders them well adapted for the formation of the beautiful color known as Prussian blue.

Mineral and Metallic Manufactures.—The mineral and metallic manufactures are those which obviously have derived most advantages from chemistry. Glass and pottery are in fact chemical manufactures. The hard-won experience of two thousand years in China has been given to Europeans by a few years' application of chemistry. Glass, made by the ancients from the ashes of ferns and other plants, is now formed by soda artificially produced from sea salt. The Exhibition showed that this manufacture, far advanced as it is, may still be susceptible of improvement; for, in the French department, glass was shown in which zinc and barytes were substituted for lead. The hardening and production of steel, the discovery of many new alloys endowed with properties most important to the arts, and the electrotyping of metals, are familiar examples of chemical appliances; but this very familiarity renders it unnecessary that I should dwell upon them. I, therefore, from want of time, leave these important manufactures, and pass on to others, in which the influence of chemistry may be less palpable to the general observer.

Soap.—Soap is probably not older than the Christian era, for the soap of the Old Testament seems to have been merely alkali. Profane history, previous to Christ, does not allude to soap, and, in all the detailed descriptions of the bath and of washing, it is never mentioned. Pliny describes its manufacture, but ascribes to it as singular a use as that given to the potato by Gerarde, who, in his "Herbal," assures us that it "is a plant from America, which is an excellent thing for making sweet sauces, and also to be eaten with sops and wines;" so Pliny, in regard to soap states, that its main purpose was to dye the hair yellow, and that men used it for this purpose much more than women. Gradually its use became more extensive, and its manufacture considerable. Soap generally consists of a fatty acid, combined with the alkali of soda. This soda was imported from Spain under the name of barilla, itself the ashes of plants grown near the sea. As these plants derived their soda from the sea, near which they flourished, chemistry, though singularly enough in the person of Napoleon Bonaparte, suggested that it might be artificially made from sea salt. A process for this was perfected, and soda derived from salt has now replaced barilla. From 1829 to 1834 the average annual import of barilla was 252,000 cwt.; it is now almost nothing. But besides this substitution, the cheapness and comparative purity of the soda made from salt is so great, that the manufacture of soap, and consequently of soda, is enormously increased, and probably exceeds ten times the largest quantity of barilla ever imported in one year into this country. Its cheapness and excellence have also had a prodigious effect on the manufacture of glass.

Chemistry has thus produced great economy and increased power of production to the manufacturers of soap by furnishing them with soda prepared directly and artificially from salt, instead of through the organism of plants. This, however, is only one of the benefits conferred on the manufacture of Chemical Science. The fiscal regulations of foreign countries rendered their tallow and fats expensive to British industry. Russia, with almost a monopoly of tallow and linseed oil, thought it good policy to sell them at high prices. But Chemistry pointed out that vegetables, as well as animals, produce similar fats. The fat of beef and mutton exists in cocoa beans; human fat in olive-oil; that of butter in palm-oil; and horse fat and train-oil are in many oily seeds. Was it, then, necessary to submit to the high prices of Russian tallow? Now, palm and cocoa-nut oil largely replace the fat of the Russian oxen and sheep, although the cheap importation of similar fats from Australia and South America has rendered the substitution less necessary.

Perfumery.—Much aid has been given by chemistry to the art of perfumery. It is true that soap and perfumery are rather

rivals, the increase of the former diminishing the use of the latter. Costly perfumes, formerly employed as a mask to want of cleanliness, are less required now that soap has become a type of civilization. Perfumers, if they do not occupy whole streets with their shops, as they did in ancient Capua, show more science in attaining their perfumes than those of former times. The Jury in the Exhibition, or rather two distinguished chemists of that Jury, Dr. Hoffman and Mr. De la Rue, ascertained that some of the most delicate perfumes were made by chemical artifice, and not, as of old, by distilling them from flowers. The perfume of flowers often consists of oils and ethers, which the chemist can compound artificially in his laboratory. Commercial enterprise has availed itself of this fact, and sent to the Exhibition, in the form of essences, perfumes thus prepared. Singularly enough, they are generally derived from substances of intensely disgusting odor. A peculiarly fœtid oil, termed "fusel oil," is formed in making brandy and whisky. This fusel oil, distilled with sulphuric acid and acetate of potash, gives the oil of pears. The oil of apples is made from the same fusel oil by distillation with sulphuric acid and bicromate of potash. The oil of pine-apples is obtained from the product of the action of putrid cheese on sugar, or by making a soap with butter, and distilling it with alcohol and sulphuric acid, and is now largely employed in England in the preparation of pine-apple ale. Oil of grapes and oil of cognac, used to impart the flavor of French cognac to British brandy, are little else than fusel oil. The artificial oil of bitter almonds, now so largely employed in perfuming soap and for flavoring confectionary, is prepared by the action of nitric acid on the fœtid oils of gas-tar. Many a fair forehead is damped with eau de millefleurs, without knowing that its essential ingredient is derived from the drainage of cowhouses. The winter green oil, imported from New Jersey, being produced from a plant indigenous there, is artificially made from willows and a body procured in the distillation of wood. All these are direct modern appliances of science to an industrial purpose, and imply an acquaintance with the highest investigations of organic chemistry. Let us recollect that the oil of lemons, turpentine, oil of juniper, oil of roses, oil of copaiba, oil of rosemary, and many other oils, are identical in composition, and it is not difficult to conceive that perfumery may derive still further aid from Chemistry.

*Candles.**—The manufacture of candles has recently been much improved by the aid of chemistry. Tallow candles, or

* I have had the advantage of seeing the admirable Report of Jury XXIX, and have availed myself, with permission of its author, of some new information contained in it.

their more expensive substitute, wax, were generally used till within the last twenty years. The tallow itself was long very impure, containing cellular tissue, which was only partially removed in the form of a scum, known as "cracklings." This impurity rendered the light unsteady, and obstructed the wick. The old method of purification still largely used in this conntry, though superseded on the continent and in Dublin, whence such good tallow candles were exhibited, has been displaced by a process of treating with sulphuric acid the tallow melted by steam. Much of the smell is thus removed, and a larger amount of purer tallow is obtained. The researches of Chevreul had shown that fats consist of fatty acids, combined with a kind of sugar named glycerin, which it was important to remove; this glycerin, removed in candle-making, is now used for liniments in cutaneous affections, and is employed as a remedy in deafness and rheumatism. By boiling with lime, an insoluble soap is formed, while the glycerin remains dissolved in the water. This lime-soap, decomposed by a stronger acid, yields the fatty acids in a pure state. But there are generally two solid acids mixed with the fluid one; and the latter is easily removed by pressure, the solid fats remaining. The solid acids are made into the beautiful candles erroneously called "stearine." Various difficulties occurred in this manufacture. The solid acids, crystallizing rapidly, were ill adapted for candles; but the introduction of arsenic in small quantity prevented the crystallization. The public were justly alarmed at this dangerous practice, and the manufacture was threatened with extinction, when it was found that a small percentage of wax produced the same effect, and that large crystals might even be prevented by a careful regulation of the temperature. This evil was therefore avoided; but a more serious one arose. The ashes of the wicks, becoming heated, cause the fatty acids to splutter; and this was a grave inconvenience. These ashes, however, form a fusible glass with borax; so the wicks are dipped into a solution of this salt, and the difficulty is removed; a salt of bismuth is also used for this purpose. Snuffers, however, are always troublesome, and a self-snuffing candle was an important want. Chemists have told us that flame is hollow, its centre containing no oxygen capable of supporting combustion; and the wick being in the hollow part, excluded from the air by its fiery prison, is charred, and diminishes the light. If the wick could be made to turn outwards, it would reach the exterior air and be consumed, whilst the glass formed by the action of the borax on its ashes would also be removed. This beautiful scientific fact was attained by the introduction of plaited and twisted wicks, the tension of the threads forcing the wick to curl outwards to the exterior of the flame, where it is rapidly burned.

Another great improvement now took place. In preparing the commercial stearine from palm-oil or tallow, it is essential to remove the glycerin, and this had been accomplished by saponifying them with alkalies. Sulphuric acid, acting on fats, unites with the oily acids and with glycerin; the former compounds are decomposed by water and become insoluble, while the latter, from being soluble, is removed; the oily acids, blackened with the destroyed organic impurities, are now distilled, and it is found that a jet of steam, heated somewhat in the manner of the hot blast, aids their distillation, the fatty acids passing over in a comparatively pure form, while the residual black resinous matter is made into black sealing wax. Candles may now be made from the distilled fatty acids at once, or they may be pressed to remove the oleic acids.

The oleic acid, both from this mode of manufacture and from that by alkaline saponification, is principally exported to France, where it is made into a hard soap. In this country we have yet to acquire the method of doing this. The excellence of the acid saponification is, that it is applicable to palm-oil and to the most impure and fœtid fats; by its means, the finest candles may be made from the waste of the glue-maker and from the oily residues obtained by the decomposition of the waste lyes of the woollen manufacturer and the bleacher. As the first beautiful process of saponification sprang from the abstract researches of Chevreul, so has the last elegant method arisen from the scientific investigations of Frèmy, although both of them have been reduced to practice, with many improvements, by the manufacturers themselves. The importance of the manufacture may be understood when I state that one company (Price's Candle Company) possesses cocoa-nut plantations in Ceylon, and employs eight hundred workmen in its five manufactories in London, using a capital of nearly half a million, and dividing profits to the extent of 40,000*l.* per annum.

Chemistry has not yet done so much for the manufacture of wax candles as might have been anticipated. Wax is still bleached by exposure to air and light, and the operation has been hastened more by mechanical than by chemical contrivances; the bleaching of wax is a tedious and often a difficult process, and demands greater attention from chemists than it has received; the Brazilian mahogany-colored wax, produced by a black bee hiving under ground, has not yet been bleached by the sun, and might be imported in considerable quantity if Chemistry offered means for removing its color. I do not allude to what Chemistry offers to do, but it would appear that paraffin and oil from coal, and possibly from peat, may dispense, to a certain extent, with the necessity for sperm-whale fishing.

Coal-Gas.—The manufacture of coal-gas is an admirable example of the benefits conferred by Chemistry in all the three divisions of its uses; for it not only has economized human power and time, but it has utilized all the products employed in removing its impurities. Coal-gas was only introduced to use at the beginning of this century, and the public prejudice which had to be overcome, and the difficulties to be surmounted in its actual manufacture, may still be remembered by many of my hearers. It was no mean innovation to replace tallow candles and oil lamps by an air streaming through pipes, but the difficulties attending its purification from noxious ingredients appeared even more insuperable than to reconcile the public to the innovation: the gas had an insupportably fœtid odor, and certainly injured health when burned; it discolored the curtains, tarnished the metals, eat off the backs of books, and covered everything with its fuming smoke. It required a man of courage, as indomitable as Winsor, its great advocate, to persuade the public to continue its use until means were found for the removal of these noxious qualities. Here Chemistry, itself the father of the manufacture, was called in consultation. The impurities in the gas are sulphuretted hydrogen, which tarnished the metals, and with sulphuret of carbon produced sulphurous fumes; ammoniacal compounds, which changed the colors of dyes and acted on leather; tarry vapors, which caused the deposition of soot; and all these had to be removed. The ammonia and the tar were partially condensed in tubes kept cool, the sulphuretted hydrogen and carbonic acid were removed by lime, and the ammonia by washing the gas with water. This last operation was the least effective, and new substitutes had to be devised, one of which I may mention; superphosphate of lime, consisting of bones dissolved in sulphuric acid, only required ammonia to make it a powerful and excellent manure; trays of this superphosphate were therefore placed in a chamber through which the gas passed, and thus the ammonia was removed, while the phosphate became enriched. A new method is now extensively employed, and shows the tendency to simplification resulting from discovery. By this method almost all the conditions of purification are satisfied by one process; the gas, after cooling, is at once taken into a chamber containing carbonate of lime and sulphate of iron; these, reacting upon each other, produce oxyd of iron and sulphate of lime. The gas, streaming through this mixture, gives up its sulphuretted hydrogen to the oxyd of iron, while the carbonate of ammonia, decomposing the lime salt, forms sulphate of ammonia and carbonate of lime, the lime thus being reconverted to its original state; the gas before being passed into this mixture is occasionally led through chlorid of calcium in order to aid the removal of the ammoniacal salt. When the mixture has done

its work it is exposed to air, and the sulphide of iron absorbing oxygen is converted into a basic sulphate of iron; hence the mixture is similar in its purifying character, except that it contains sulphate of ammonia, which may be washed out and preserved, while the residue is employed over and over again. By this elegant process the noxious sulphur compounds are utilized in the fabrication of sulphate of ammonia, and the mixture seems never weary of performing its duty; hence not only is the purification performed at one process, but the noxious ingredients are converted into compounds of much value. The waste and badly-smelling products of gas-making appeared almost too bad and fœtid for utilization, and yet every one of them, Chemistry, in its thriftiness, has made almost indispensable to human progress; the badly-smelling tar yields benzole, an ethereal body of great solvent powers, well adapted for preparing varnishes, used largely for making oil of bitter almonds, of value for removing grease-spots, and for cleansing soiled white kid gloves. The same tar gives naphtha, so important as a solvent of Indian rubber and gutta percha; similar tar, when made from wood, yields creosote, a powerful preservative of animal matter, and much employed as a medicinal agent. Coal tar furnishes the chief ingredient of printer's ink, in the form of lampblack; it substitutes asphalte for pavements; it forms a charcoal when mixed with red-hot clay, that acts as a powerful disinfectant. When the tar is mixed with the coal-dust, formerly wasted in mining operations, it forms by pressure an excellent and compact artificial fuel; the water, condensed with tar, contains much ammonia, readily convertible into sulphate of ammonia, a salt now recognized as being of great importance to agriculture, and employed in many of the arts. Cyanids are also present among the products of distillation, and these are readily converted into the beautiful color known as Prussian blue. The naphthaline, an enemy to the gas-manufacturer by choking the pipes, may be made into a beautiful red coloring matter, closely resembling that from madder. This, by its transformation, promises an important, though hitherto not yet realized useful product. Coal, when distilled at a lower temperature than that required to form gas, produces an oil containing paraffin, largely used as an antifrictional oil for light machinery.

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Art. V.—*Abstract of a Memoir on Polymerous Isomorphism, by* Th. Scheerer.*

This important paper covers nearly 100 pages in Poggendorff's Annalen and presents a review of the subject of polymerous isomorphism as developed by Scheerer, together with numerous new analyses of minerals, especially the magnesian. The two great points which the author considers as established are—

1. That 1 atom of Ṁg may be replaced by 3 atoms of Ḣ.
2. That 2 atoms of S̈i may be replaced by 3 of Ä̇l.

We present our readers with an abstract of his paper, citing in its illustration the new analyses.

I. Amphibolic Talc and Amphibole.

1. *Foliated Talc.*

	S̈i	Ä̇l	Ḟe	Ṁg	Ḟe	Ṅi	Ḣ	
1. Fol. talc, Tyrol,	62·38	...	...	31·19	1·42	0·20	4·73= 99·92	G.=2·69
2. " "	62·12	...	...	31·15	1·58	0·24	4·73= 99·82	
3. " " Yttre-Sogn,	61·54	...	...	30·56	2·35	0·31	4·93= 99·69	G.=2·70
4. " " "	61·69	...	...	30·62	2·33	0·29	4·94=100·14	
5. " " Röraas,	61·98	0·04	...	30·41	1·59	....	5·04= 99·06	G.=2·78
6. " " "	62·03	0·03	...	30·62	1·57	0·32	5·04= 99·61	
7. " " Raubjerg,	61·85	0·13	...	31·61	1·18	0·36	5·13=100·26	G.=2·79
8. " " "	61·63	0·16	...	31·37	1·20	0·39	5·13= 99·88	
9. " " Tyrol, slaty,	60·95	0·48	...	31·26	1·43	0·35	5·29= 99·76	G.=2·76
10. " " "	61·16	0·46	...	31·17	1·40	0·39	5·31= 99·89	
11. Potstone, Zöblitz,	60·14	0·75	0·45	30·17	2·05	0·28	5·71= 99·55	G.=2·80
12. "	60·31	0·79	0·45	29·94	2·11	0·30	5·87= 99·77	
13. Scaly talc, Canton-Wallis,	62·34	0·35	...	31·96	0·61	....	4·82=100·08	G.=2·79
14. " " "	62·55	0·44	...	32·00	0·73	....	4·84=100·56	Rr.†
15. " " Styria,	62·37	0·32	...	32·02	0·65	....	4·81=100·17	
16. " " Fahlun,	56·95	4·92	0·72	30·09	0·94	....	6·07= 99·69	
17. " " "	57·10	4·69	0·81	30·11	1·07	....	6·07= 99·85	
18. Fol. talc, white, St. Goth.	60·85	1·71	...	32·08	0·09	....	4·95, Ċa *trace*=99·68	
19. Col. fol. talc, "	62·85	1·44	...	30·76	0·20	....	4·55, Ċa 0·42=100·22	
20. " " "	62·15	1·01	...	33·04	0·38	....	3·21, " 0·07= 99·86	

The oxygen relation for the silica, protoxyds and water of the first four of these analyses is $32{\cdot}00 : 12{\cdot}80 : 4{\cdot}72 = 15 : 6 : 2$. This ratio corresponds to the formula, according to the Berzelian method,

$$\dot{R}^6\ddot{S}i^2 + 2\dot{H} \quad \text{or} \quad 3\dot{R}\ddot{S}i + \dot{R}^3\ddot{S}i^2 + 2\dot{H}.$$

which corresponds to S̈i 62·61, Ṁg 32·51, Ḣ 4·88=100.

On the ground that 3Ḣ replace 1Ṁg, the ratio becomes $15 : 6\frac{2}{3} = 45 : 20 = 9 : 4$, the oxygen ratio of hornblende.

Scheerer also reviews the analyses 5 to 20 in which alumina exists, substituting 2S̈i for 3Ä̇l, and brings out the same ratio 9 : 4.

2. *Asbestiform Talc.*

	S̈i	Ä̇l	Ṁg	Ċa	Ḟe	Ḣ
21. St. Gothard,	61·51	0·83	30·93	3·70	0·12	2·84=99·93

* Pogg. Ann., lxxxiv, p. 321. † Analysis made by Hrn. Richter.

The oxygen ratio is 31·94 : 0·39 : 13·46 : 2·52, giving according to Scheerer's theory of substitutions, 32·20 : 14·30 = 9 : 4, the hornblende ratio. The same locality affords tremolite and foliated talc, and this ratio is common to both.

3. *Columnar Talc.*

Includes hydrous anthophyllite.

4. *Sparry Crystalline Talc.*

		$\ddot{S}i$	$\dot{A}l$	$\dot{M}g$	$\dot{F}e$	$\dot{H}$	
23.	Fenestrelles, Piedmont,	61·96	...	31·02	1·47	4·92= 99·37	G.=2·79
24.	" "	62·29	0·15	31·55	1·22	4·83=100·04	
25.	Indur't'd Talc, Gloggnitz,	62·47	0·13	32·08	0·47	4·78= 99·93	G.=2·78
26.	" "	62·69	0·12	32·41	0·39	4·70=100·31	Rr.

The oxygen ratio is the same as for the *first* group 15 : 6 : 2, and the hornblende ratio 9 : 4 is deducible in the same way.

5. *Massive Crystalline Talc.*

		$\ddot{S}i$	$\dot{A}l$	$\dot{M}g$	$\dot{F}e$	$\dot{H}$	
27.	Steatite, Wunsiedel,	62·03	....	31·44	1·88	4·96=100·31	Rr.
28.	" "	61·98	*trace*	31·17	1·48	4·81= 99·44	
29.	" pseudom.	62·07	0·39	31·13	1·69	4·83=100·11	
30.	" "	62·35	*trace*	31·32	1·24	4·78= 99·79	
31.	" Parma.	62·18	....	30·46	2·53	4·97=100·14	Rr.
32.	Agalmatolite, China,	61·48	....	31·27	1·65	4·86= 99·26	
33.	" "	62·30	0·06	31·32	1·62	4·89=100·19	

The oxygen ratio of No. 27, is 32·21 : 0·00 : 12·99 : 4·41, (and the others are nearly the same) giving the ratio again 15 : 6 : 2, or the hornblende ratio 9 : 4. The older analyses are also reviewed.

6. *Amorphous Talc.*

		$\ddot{S}i$	$\dot{A}l$	$\dot{M}g$	$\dot{C}a$	$\dot{F}e$	$\dot{H}$	$\ddot{C}$	
34.	Meerschaum, Turkey,	61·17	...	28·43	...	0·06	9·83.	0·67=100·16	
35.	" "	61·49	...	28·13	0·60	0·12	9·82	0·67=100·83	Rr.
36.	" Greece,	61·30	...	28·39	...	0·08	9·74	0·56=100·07	
37.	" doubtful loc.,	58·20	...	27·73	1·53	...	9·64	2·73= 99·83	Rr.
38.	" "	60·45	0·11	28·19	...	0·09	9·57	1·74=100·15	

Considering the $\ddot{C}$ and $\dot{C}a$ combined as carbonate of lime, the oxygen ratio for No. 34 is 31·76 : 11·14 : 8·74; for No. 36, 31·83 : 11·17 : 8·66; for No. 37, 30·22 : 10·54 : 8·57. Substituting $3\dot{H}$ for $1\dot{M}g$, the first corresponds to 31·76 : 14·05, which equals (and so with the others) the ratio 9 : 4.

7. *Hornblende.*

The two analyses of Crocidilite by Stromeyer, afford the mean oxygen ratio for the silica, protoxyds and water, 26·60 : 10·40 : 4·26, whence the formula $4\dot{R}\,\ddot{S}i + \dot{R}^2\,\ddot{S}i^2 + 3\dot{H}$. But adding one-third of 4·26 to 10·40, the ratio becomes 26·60 : 11·82, or 9 : 4, which is that of hornblende. A tremolite from Reichenstein afforded—

	$\ddot{S}i$	$\dot{A}l$	$\dot{M}g$	$\dot{C}a$	$\dot{F}e$	$\dot{H}$	
39.	58·89	0·67	23·37	9·57	3·79	3·60=99·89,	Rr.

giving the oxygen ratio, 30·58 : 0·31 : 12·92 : 3·20, which becomes by the author's theory 30·79 : 13·99, or 9 : 4 nearly. We pass by Scheerer's review of some earlier analyses.

II. Augitic Talc and Augite.

1. *Foliated Talc.*

	$\dot{S}i$	$\dot{A}l$	$\dot{F}e$	$\dot{F}e$	$\dot{M}g$	$\dot{H}$	
40. Gastein,	51·06	5·37	3·13	4·68	28·46	7·28	=99·98, Rr.
42. "	49·74	5·72	3·20	6·12	27·32	7·85,	Cu 0·30=100·25

These analyses give the ratios 26·51 : 3·45 : 12·42 : 6·47, and 25·83 : 3·63 : 12·22 : 6·98, equivalent nearly to 8 : 1 : 4 : 2. The author by his theory deduces the ratios 28·81 : 14·58, and 28·25 : 14·54, each very nearly 2 : 1, or the *augite ratio.*

2. *Sparry Crystalline Talc.*

	$\dot{S}i$	$\dot{A}l$	$\dot{M}g$	$\dot{C}a$	$\dot{F}e$	$\dot{M}n$	$\dot{H}$
44. Talc Diallage, Presnitz,	58·46	0·09	32·83	0·61	1·09	...	6·56=99·64
45. " "	58·60	0·06	32·07	0·81	1·01	0·39	6·56=99·50

Mean oxygen ratio, 30·40 : 0·04 : 13·46 : 5·83, becoming by Scheerer's theory 30·43 : 15·40, or nearly 2 : 1. Some old analyses are reviewed and a like result deduced.

3. *Massive Talc.*

	$\dot{S}i$	$\dot{A}l$	$\dot{M}g$	$\dot{C}a$	$\dot{F}e$	$\dot{M}n$	$\dot{H}$
46. Neolite, Arendal,	52·28	7·33	31·24	0·28	3·79	0·89	4·04=99·85
47. " "	47·35	10·27	24·73	...	7·92	2·64	6·28=99·19

These give the oxygen ratios 27·15 : 3·42 : 13·62 : 3·59, and 24·58 : 4·80 : 12·24 : 5·58, equivalent approximately to 8 : 1 : 4 : 1 or 10 : 2 : 5 : 2. Scheerer deduces by his method, the ratios 29·43 : 14·82 and 27·78 : 14·10, or nearly 2 : 1, the augite ratio. [It may be observed that, throwing out the alumina and water, the remaining ratio is 27·15 : 13·62 for the first, and 24·58 : 12·24 for the second, each very closely 2 : 1.]

	$\dot{S}i$	$\dot{A}l$	$\dot{M}g$	$\dot{C}a$	$\dot{F}e$	$\dot{H}$	
48. Neolite of Eisenach,	51·16	9·61	29·65	1·91	0·82	6·50=	99·65
49. " "	51·35	9·02	30·19	1·93	0·79	6·50=	99·78
50. " "	51·44	8·79	31·11	2·00	$\dot{F}e$ 0·88	6·50=	100·72 Rr.

Oxygen ratios, 26·56 : 4·49 : 12·59 : 5·78, 26·66 : 4·21 : 12·80 : 5·78, and 26·71 : 4·40 : 13·02 : 5·78, giving by the new theory 29·56 : 14 : 51, 29·47 : 14·73, 29·64 : 14·94, each =2 : 1.

4. *Nephrite.*

	$\dot{S}i$	$\dot{A}l$	$\dot{M}g$	$\dot{C}a$	$\dot{F}e$	$\dot{H}$	
51. Nephrite, Turkey,	57·49	0·67	25·86	12·01	1·34	2·55=	99·92
52. " "	57·28	0·68	25·91	12·39	1·37	2·55=	100·18
53. " N. Zealand,	57·10	0·72	23·29	13·48	3·39	2·50=	100·48

Oxygen ratios, 29·85 : 0·31 : 14·07 : 2·27.—29·74 : 0·32 : 14·21 : 2·27.—29·65 : 0·34 : 13·92 : 2·22

Scheerer's ratios, 30·06 : 14·83 29·95 : 14·96 29·87 : 14·66

approaching in each case 2 : 1.

5. *Augite.*

	$\ddot{S}i$	$\dot{M}g$	$\dot{C}a$	$\dot{F}e$	$\dot{H}$	
54. Rock Cork, Zillerthal,	57·20	22·85	13·39	4·37	2·42	=100·24
55. Asbestus, Tyrol,	57·50	23·09	13·42	3·88	2·36	=100·25
56. " Reichenstein,	55·85	23·99	11·66	5·22	2·15, $\dot{A}l$ 0·56, $\dot{C}u$ 0·40	=99·83, Rr.
57. Diopside, Reichenstein,	54·50	18·96	21·41	3·00	1·19, $\dot{A}l$ 1·10	=100·16, Rr.

Oxyg'n ratios, (1) 29·70 : 13·94 : 2·16, (2) 29·86 : 13·93 : 2·10, (3) 29·00 : 0·26 : 14·09 : 1·91, (4) 28·30 : 0·51 : 14·37 : 1·07.

A rock leather analysed gave the composition of serpentine, $(\dot{M}g)^3\ddot{S}i$.

III. Talc not Augitic or Hornblendic in type.

	$\ddot{S}i$	$\dot{A}l$	$\dot{M}g$	$\dot{F}e$	$\dot{H}$	
58. Hydrotalc, Presnitz,	67·81	...	26·27	1·17	4·13	= 99·38
60. " "	68·47	0·12	26·31	1·19	4·11	=100·20
62. Sub-columnar,	67·95	0·24	25·54	1·59	4·14	= 99·46, Rr.

Ox. ratios, (1) 35·21 : 0·00 : 10·77 : 3·67. (2) 35·55 : 0·06 : 10·79 : 3·65. (3) 35·28 : 0·11 : 10·57 : 3·68
Scheerer's ratios, 35·21 : 11·99 35·59 : 12·01 35·26 : 11·80

The first set of ratios correspond to 10 : 3 : 1; Scheerer's set, to 3 : 1, and the formula $(\ddot{R})\ddot{S}i$.

Conclusion.—The three general rations deduced by Scheerer for the species reviewed, are 9 : 4, 4 : 2, 3 : 1, corresponding, the first to hornblende, $\ddot{R}\ddot{S}i+\ddot{R}^3\ddot{S}i^2$; 2d to augite $\ddot{R}^3\ddot{S}i^2$; 3d to $\ddot{R}\ddot{S}i$.

From the alleged isomorphism of $1\dot{M}g$ and $3\dot{H}$, and of $2\ddot{S}i$ and $3\dot{A}l$, the following formulas are equivalents and the substances presenting them should be isomorphous—

$(a)\ \ddot{R}^3\ddot{S}i^2$, $(b)\ \ddot{R}^2\ddot{S}i^2+3\dot{H}=2\ddot{R}\ddot{S}i+3\dot{H}$, $(c)\ \ddot{R}\ddot{S}i^2+6\dot{H}$, $(d)\ \ddot{S}i^3+9\dot{H}$.

The minerals of the *Augitic* series whose composition is given, are compounds according to Scheerer, of (a) and (b) in different proportions. In a like manner, those of the *Hornblendic* series are considered as composed of the compounds $\ddot{R}\ddot{S}i+\ddot{R}^3\ddot{S}i^2$ (a), and $3\ddot{R}\ddot{S}i+3\dot{H}$ (b) in different proportions: and those of the *Hydrotalc* series, of the compounds $2\ddot{R}\ddot{S}i$ (a), and $\ddot{R}\ddot{S}i^2+3\dot{H}$ (b) in different proportions. His paper contains a table of the results, in which the ratios of the two constituent portions are given, with the calculated and found results, in accordance with the ratios. We give a few examples, (referring to the paper for the complete table.)

1. *Hornblendic Series.*

		Oxygen ratios.	Combinat'n of Stochiometric elements.
1. Colum. talc, St. Got., (11) (1·44 $\dot{A}l$, 3·21$\dot{H}$)	Found	32·59 : 13·32 : 2·85	$=3a+b$
	Calc.	32·59 : 13·58 : 2·72	
2. Asbest. talc, ibid, (12) (10·83 $\dot{A}l$, 2·84 $\dot{H}$) (3·70 $\dot{C}a$)	Found	32·20 : 13·46 : 2·52	$=3a+b$
	Calc.	32·20 : 13·42 : 2·68	
3. Talc, Tyrol, (1) (0·0 $\dot{A}l$, 4·73 $\dot{H}$)	Found	32·26 : 12·86 : 4·20	$=3a+2b$
	Calc.	32·26 : 12·90 : 4·30	
21. Meerschaum, (21) (0·11 $\dot{A}l$, 9·57 $\dot{H}$)	Found	31·43 : 10·66 : 8·51	$=3a+9b$
	Calc.	31·43 : 11·35 : 7·86	
22. Nephrite, Turkey, (27) (0·68 $\dot{A}l$, 2·55$\dot{H}$) (12·39 $\dot{C}a$)	Found	29·95 : 14·21 : 2·27	$=6a+b$
	Calc.	29·96 : 14·26 : 2·14	

2. *Augitic Series.*

34. Asbest., Tyrol (30) (0·Äl, 2·36 Ĥ, 13·42 Ča) { Found 29·86 : 13·93 : 2·10 / Calc. 29·86 : 14·21 : 2·13 } = 6*a* + *b*

3. *Hydro-talc Series.*

41. Talc, Presnitz (33) (0·12 Äl, 4·11 Ĥ) { Found 35·59 : 10·97 : 3·65 / Calc. 35·59 : 10·68 : 3·56 } = 4*a* + *b*

A second table presents the series of species under the hornblendic and augitic divisions, in the order of their variation in form and composition from the typical species, hornblende and augite; and the tendency to foliated crystallizations, as the species become hydrous is illustrated. Anthophyllite is placed as intermediate between true hornblende and hornblendic talc, while diallage, in the augitic series, is intermediate between true augite and augitic talc.

Art. VI.—*Remarks on* Menodora, *Humb. & Bonpl., and* Bolivaria, *Cham. & Schlecht.;* by Asa Gray.

Having been requested to report upon a collection of plants made last year, *en route* from Texas to El Paso, New Mexico, by Mr. Wright, while attached to Col. Graham's surveying party, I have been led, in anticipation of the regular study of the *Monopetalæ* of various collections now in my hands, to inquire whether *Bolivaria* is or is not generically distinct from *Menodora*. The latter genus was established on a Mexican plant, by Humboldt and Bonpland, in their *Plantes Æquinoctiales*, 2, p. 98, t. 110, and is re-described by Kunth, in the *Nova Genera et Species Plantarum*, 7, p. 199, from a specimen not in fruit. The former was founded by Chamisso and Schlechtendal, in the first volume of the *Linnæa* (1826), on two Buenos Ayrean species. The question of the order to which these plants should be referred, has, perhaps, been sufficiently discussed by Lindley,* who says they are genuine Jasminaceous plants; by Grisebach,† who created for them a distinct family, Bolivariaceæ; and by Alphonse De Candolle,‡ who again refers them to Jasmineæ. He does not admit them to form a separate tribe in that small order, although he corrects Grisebach's character of the æstivation of the corolla (which is not contorted, as in Jasminum, but imbricative), and considers the remaining and more important character of the four ovules in each cell of Bolivaria to be invalidated by the single pair in each cell, attributed to Menodora.

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* Natural System of Botany, ed. 2, (1836) p. 239.
† Genera et Species Gentianearum, (1839) p. 20.
‡ Prodromus Syst. Veg., 8, p. 300, note.

It is on this latter ground, mainly, that De Candolle distinguishes the two genera, *Menodora* having, according to Bonpland, only two ovules in each cell, a *two-valved* capsule, and a 10–13-cleft calyx; while *Bolivaria* has four ovules in each cell, a circumscissile dehiscence of the capsule, and, as to the original species, a five-parted calyx. The bivalvular dehiscence of Menodora rests wholly on the statement of Bonpland (the fruit being unknown to Kunth and to Grisebach), which I have some reason to think is not correct. At least, the ovary in a Coulterian specimen of what I take to be *Menodora helianthemoides*, shows manifest indications of the transverse dehiscence of Bolivaria. The character of the ovulation would seem to be confirmed by Kunth (*Nova Genera & Spec., l. c.*); but Grisebach may have found it different in the specimen he examined, as he gives the character "loculis 4-ovulatis" to his Bolivariaceæ, without exception. There are certainly four ovules in each cell, superposed in pairs, in No. 937 of Coulter's Mexican collection, which agrees so minutely with the description that I do not hesitate to consider it as Humboldt's species; especially as the ovules stick together a little, so that the mistake as to their number might easily have occurred. If it was examined, the same mistake must have occurred in respect to De Candolle's second species, *Menodora heretophylla;* in which the cells are equally 4-ovulate, both in wild and in cultivated specimens. On the other hand, the Patagonian *Bolivaria robusta* of Bentham, in *Lond. Jour. Bot.*, 5, p. 190, t. 5, (of which indeed the fruit is unknown, but which has only a 5–6-lobed calyx,) is said to have only a single pair of ovules in each cell. As the last mentioned species has frequently six lobes to the calyx, and one of our new Texan species has sometimes as few as seven, it is evident that this remaining character is of no generic consequence.

The genus *Bolivaria* must therefore be merged in *Menodora*, as Sir Wm. Hooker proposed, when publishing his *M. Africana*.*

One Texan species, *M. heterophylla* of Moricand, has already been published. It was gathered by Berlandier, Drummond, and all later collectors in that country. An allied New Mexican species, with narrow and entire leaves, was collected by Wislizenus, Fendler, and Gregg, and has been named by Dr. Engelmann, *Bolivaria scabra*. Another, found in Texas by Lindheimer and by Wright, and appropriately called by Dr. Engelmann, *Bolivaria longiflora*, is remarkable for the prolonged tube of the corolla; differing from the genuine species just as Lithospermum longiflorum, L. canescens, &c., differ from L. officinale. These three

* Icones Plantarum, 6, (1843) t. 586. The æstivation of the lobes of the corolla of this plant is described as "contorto-imbricated," but figured (fig. 3) as if regularly contorted.

have been cultivated by Dr. Engelmann and myself for the last three years, and Dr. Engelmann sent me characters of them in the autumn of 1850. He noticed that, while the *Brevifloræ* (his *Bolivaria heterophylla* and *B. scabra*) open their flowers in the morning, and are inodorous; the *Longifloræ* (*B. longiflora*) expand their blossoms, which are fragrant, at or towards evening. He also remarked that the anthers of B. longiflora are almost sessile, and included within the summit of the narrow tube, which is glabrous; while in the others, the anthers are exserted on slender filaments, and the throat of the corolla is more or less hairy within. The style, moreover, is less exserted in B. longiflora, and the lobes of the corolla are rather conspicuously pointed. All these characters are confirmed by a second species, if such it be, which I find in Mr. Wright's collection of 1851. Perhaps it is no more than a hairy variety of the last. These are far the most showy plants of the genus, their pure yellow corollas being from an inch and a half to two inches long; and they continue to blossom for a long time, though not so long as M. heterophylla, which flowers through the whole growing season.

The known species may be thus disposed.

MENODORA, *Humb. & Bonpl.*

Menodora & Bolivaria, *Cham. & Schlecht., Griseb., D C. ll. cc.*

§ 1. Bolivaria, *Cham. & Schlecht.* Calyx 5-lobus, raro 6-lobus. Corolla campanulata seu infundibuliformis, lobis acutiusculis. Filamenta filiformia corollam subæquantia; antheris muticis.

* *Lobi calycis lineares tubo longiores.*

1. M. integrifolia, *Steud.* Bolivaria integrifolia, *Cham. & Schlecht., Linnæa*, 1. *p.* 207, *t.* 4, *f.* 1; *Hook. & Arn., Jour. Bot.*, 1, *p.* 284; *DC. Prodr.*, 8, p. 315. Buenos Ayres.

2. M. trifida, *Steud.* Bolivaria trifida, *Cham. & Schlecht., l. c.; Hook. & Arn., l. c.; DC.* l. c. Buenos Ayres, Mendoza.

* *Lobi calycis triangulares tubo subduplo breviores.*

3? M. robusta. Bolivaria robusta, *Benth. in Lond. Jour. Bot.*, 5, *p.* 190, *t.* 5. Patagonia.—Ovarii loculi dicitur biovulati!

§ 2. Menodora, *Humb. & Bonpl.*—Calyx 10–14-lobus, rarius 7–9-lobus; lobis linearibus setaceisve tubo corollæ breviter infundibuliformis vel subrotatæ (fauce pl. m. barbatæ, limbo 5-partito, lobis obovatis oblongisve vix mucronulatis) longiores. Filamenta filiformia; antheris muticis.

* *Stigma obtusum parvum. Folia bipinnatisecta..*

4. M. AFRICANA, *Hook. Ic. Pl.* 6, *t.* 586. Africa Australis.

** *Stigma discoideum vel depresso-capitatum subbilobum.*

† Corollæ majusculæ lobi oblongo-lanceolati (ex auct.)

5. M. DECEMFIDA. Bolivaria decemfida, *Gill. in Hook. Jour. Bot.*, 1, *p.* 284; *DC.* l. c. Mendoza.

†† Corollæ lobi sæpius obovati. Caules diffusæ vel decumbentes. Pedunculi solitarii, nunc pseudo-laterales, fructiferi recurvati.

‡ Foliis integerrimis.

6. M. HELIANTHEMOIDES (*Humb. & Bonpl. Pl. Æq.*, 2, *p.* 98, *t.* 110): hirtello-pubescens; foliis ovalibus seu elliptico-oblongis in petiolum angustatis; corollæ lobis late obovatis calycis lacinias anguste lineares plus duplo superantibus.—Mexico, *Humboldt & Bonpland*, Coulter (No. 937).—A thin annular disk adheres to the very base of the ovary: its edge marks the line where the pod will evidently dehisce transversely. The fruit is not known.

7. M. COULTERI (sp. nov.): glabra, vix puberulo-scabra; foliis linearibus basi attenuatis, infimis sublanceolatis; corollæ lobis obovato-oblongis calycis lacinias setaceas plusduplo superantibus. —Mexico, *Coulter* (No. 938).—The lobes of the corolla are half an inch in length, about as long as in the foregoing species but narrower, and also more pointed. Lobes of the calyx not longer than the ripe pod, which is on a recurved peduncle.

‡‡ Foliis plerisque 3–5-fidis.

8. M. HETEROPHYLLA (*Moricand in DC. Prodr.* 8, *p.* 316): glabella; foliis caulinis præsertim inferioribus oblongis cuneatisve 3–5-fidis segmentis vel integerrimis vel 2–3-lobatis, summis seu paucis intermediis linearibus integerrimis; corollæ lobis obovatis calycis lacinias lineari-subulatas duplo superantibus.—Texas, *Berlandier*, *Drummond*, *Lindheimer*, *Wright*, etc. Camargo, Mexico, *Gregg*.—Flowers light yellow, externally often tinged with purple.

††† Corollæ lobi obovati. Caules erecti apice plerumque corymbosi; pedunculis floriferis et fructiferis erectis.

9. M. SCABRA: foliis inferioribus oblongo-lanceolatis superioribus lineari-lanceolatis integerrimis (rarissime 2–3-dentatis) caulibusque scabrellis; corollæ lobis late obovatis calycis lacinias 7–10 setaceas duplo superantibus; calyce fructifero coccos haud excedentibus.—Bolivaria scabra, *Engelm., Mss.* New Mexico, *Wislizenus*, *Fendler* (No. 693), *Wright* (No. 563). Saltillo, Mexico, *Gregg* (No. 527).—Corolla small, its lobes only 3 or 4 lines long. Lobes of the calyx 2 or 3 lines long.

10. M. MEXICANA. Bolivaria Mexicana, *Alph. DC. Prodr.* 8, *p.* 315. Oaxaca, Mexico, *Andrieux.* "Corolla calyce sublongior. Calycis lobi semipollicares." *DC.*—From the length of calyx-lobes and the size of the corolla, this can scarcely be No. 7 or No. 9.

§ 3. MENODOROPSIS. Calyx 10-lobus, lobis setaceis. Corolla longe tubulosa, hypocraterimorpha, intus glabra; lobis subovatis mucronato-acuminatis. Antheræ fauce inclusæ subsessiles, oblongo-lineares, mucrone apiculatæ.—Flores vespertinæ, odoratæ.

11. M. LONGIFLORA: glabra; caulibus erectis subsimplicibus; foliis lanceolatis vel inferioribus oblongis integerrimis (infimis rarissime trilobatis); pedunculis terminalibus confertis subcymosis erectis; tubo corollæ sesqui-bipollicari lobis suis laciniisque calycis setaceis pluries longioribus.—Bolivaria longiflora, *Engelm. Mss.* Texas, *Lindheimer* (No. 652, &c.), *Wright* (No. 564).—Stems 12–18 inches high, rather strict. Leaves one to two inches long. Flowers bright yellow. Cocci of the capsule 3 or 4 lines in diameter, shorter than the calyx-lobes.

12. M. PUBENS (sp. nov.): pube molli brevi patente subcinerea; foliis oblongis superioribus oblongo-lanceolatis: cæt. ut in præcedente.—New Mexico, *Wright*, 1851.

ART. VII.—*Chemical Examination of a few Minerals associated with Serpentine;* by T. H. GARRETT.*

1. CHROME ORE.

Massive Chrome Iron.—This mineral, as is well known, is found in large quantities in the serpentine range which extends through Delaware, Chester and Lancaster counties, Pa., occurring as a sand, derived from the disintegration of the serpentine, or in a few instances in well-defined veins of nearly pure ore. The most remarkable vein, perhaps in the world, is that known as Wood's Pit in Chester county, a short distance from the village of Texas, where it is so compact as to require blasting for its extraction. Thousands of tons of rich ore have already been extracted from this mine.

Among other minerals which are found with chromic iron, is the hydrated carbonate of nickel or emerald nickel, which occurs in a thin coating lining interstices and joints in the ore, and sometimes disseminated through the whole mass.

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* Communicated for this Journal by Prof. J. C. Booth.

To ascertain whether nickel was contained in the ore where it was not visible, as well as to determine the richness of the ore in chrome, I selected a specimen for analysis which had a slight coating of emerald nickel upon one side. This coating having been carefully removed, the rest was broken into minute pieces, and those rejected on which a trace of nickel was visible. The ore itself was jet black, shining and submetallic, very compact, rather brittle, with uneven fracture. Hardness 5·5; streak brown; specific gravity 4·568.

The specimen, having been finely pulverized, was analyzed in the usual manner, by fusion first with bisulphate of potassa, and afterwards with a mixture of carbonate of soda and nitrate of potassa. The chromic acid thus obtained in combination with the alkalies, was deoxydized by alcohol and precipitated as chromic oxyd by ammonia. The nickel was separated from the iron by hydrosulphuret of ammonia and dilute hydrochloric acid. The several constituents were carefully reëxamined, and the absence of alumina determined. The following was the result of the examination:

Cr_2O_3	-	-	-	-	63·384
Fe_2O_3	-	-	-	-	38·663
NiO	-	-	-	-	2·282

The analysis calculated into the formula RO, R_2O_3, excluding the nickel, gives $FeO\,Cr_2O_3$ 93·164 + $FeO\,Fe_2O_3$ 5·298 + NiO 2·282 = 100·744. If the nickel be included in the calculation it gives $FeO\,Cr_2O_3$ 93·164 + $FeO\,Fe_2O_3$ ·591 + $NiO\,Fe_2O_3$ 7·150 = 100·905. This specimen approaches nearer to the pure chromic iron ($FeO\,Cr_2O_3$) than is indicated by any analysis that I have yet seen. As the minute fragments exhibited not the slightest appearance of nickel, it is evident that the metal is either present as sesquioxyd, and therefore mechanically mingled with the ore, which is unlikely, or it belongs to the formula, as a replacement of protoxyd of iron, which I regard as the most probable view.

Chrome Sand.—A large proportion of the chrome ore that is exported from this country, is obtained by washing the deposits of sand which form in the beds of streams flowing from the serpentine. The method of washing employed is similar to that used for washing deposit gold, and depends upon the same principle, viz., that the metalliferous portions are much heavier than the siliceous, and consequently remain when the latter are washed away. The deposit being first sifted in water with hand sieves, to separate the coarse gravel, the finer sand is then thrown into sloping troughs, through which a stream of water is made to pass, and constantly raked up against the current until all the lighter matter is removed. The chrome sand on account of its superior gravity remains at the bottom of the trough. The

washing process is carried on at numerous points along the serpentine range in the three counties already mentioned.

At the washings situated about six miles west of the town of Chester, the sand in which the chrome occurs, contains a large amount of bright green *actinolite* of which good specimens may be obtained. As the chrome sand itself in this locality consists almost entirely of small but very perfect octohedra, it might be supposed to be richer in chrome than the massive ore which I had examined. The pure sand, separated from all foreign matter, was analyzed by Mr. Isaac Starr in Prof. Booth's Laboratory with the following results:

SiO_3	-	-	-	-	0·619
Cr_2O_3	-	-	-	-	60·836
Fe_2O_3	-	-	-	-	38·952
Al_2O_3	-	-	-	-	0·928
NiO	-	-	-	-	0·100

The proportions calculated according to the formula are, FeO Cr_2O_3 89·419 + FeO Fe_2O_3 6·254 + FeO Al_2O_3 1·578 + SiO_3 ·619 + NiO ·100 = 97·970.

The specimen being perfectly pure, proves the substitution of alumina for chromic oxyd. The analysis further shows that the pure crystallized sand is not richer in chrome than the pure massive ore. The association of nickel with the sand is interesting, although present in small quantity, for the locality is some thirty or forty miles from that of the massive chrome containing emerald nickel.

Magnetic Chrome Sand.—Having observed that most if not all chrome sands contain more or less that is magnetic, I thought it a question of sufficient interest to determine whether the magnetic portion contained chrome. For this purpose a quantity of the sand was extracted by a magnet, and this magnetic part treated several times successively by the magnet to free it entirely from adhering chrome sand. The sand thus obtained consisted entirely of magnetic grains. Being then analyzed by the process indicated above, it yielded the following result:

SiO_3	-	-	-	-	1·25
Cr_2O_3	-	-	-	-	41·55
Fe_2O_3	-	-	-	-	62·02

Calculated, as before, into the formula RO, R_2O_3, it gives, FeO Cr_2O_3 61·07 + FeO Fe_2O_3 38·64 + SiO_3 1·25 = 100·96. From which we may infer that the presence of as small a proportion as 38 pr. ct. of magnetic iron is sufficient to render the whole magnetic. It is moreover clear, that, although the magnetic portion of chromic iron contains a smaller per-centage of oxyd of chrome than the non-magnetic portion, yet it contains a large proportion available for the manufacture of the chromates, and that therefore a magnet will not reveal the property of a chrome

ore. The larger contact of oxyd of iron is only so far detrimental, as it impedes the action of the alkalies and oxygen to form a chromate, and hence, within reasonable limits, the economic value of a chrome ore is almost in direct proportion to the per-centage of oxyd of chrome. The most serious injury to the value of chrome ore lies in the per-centage of silex which consumes a proportionally large amount of costly alkali.

ART. VIII.—*On Remingtonite, a new Cobalt Mineral;* by JAMES C. BOOTH.

REMINGTONITE occurs as a rose-colored coating, one-hundredth of an inch in thickness, very soft and earthy, opake, with a pale, rose-colored streak.

In a mattrass it yields water and darkens; gives with borax and microcosmic salt, first a feeble reaction of iron, and finally, when the bead cools, a deep blue color of cobalt. It dissolves in muriatic acid with a slight effervescence, and a nickel-green color, the latter property indicating iron associated with it; for pure oxyd of cobalt dissolves with a blue color, and requires but a small quantity of iron to change the blue to green. The solution, neutralized by ammonia, precipitated by sulphide of ammonium, and then treated with muriatic acid, left a large amount of black sulphide of cobalt; while the muriatic solution yielded a small amount of sulphide of iron. The metal is, therefore, almost wholly cobalt. Since a little arsenic is associated with carollite, this mineral was tested for arsenic, but yielded not a trace of it.

Although the above experiments were performed on about $\frac{1}{10}$th of a grain, yet the mineral is clearly proved to be a hydrocarbonate of cobalt. The quantity was, however, much too small to determine its formula.

Remingtonite coats thin veins of serpentine, which traverse hornblende and epidote, and its association with serpentine, containing both magnesia and lime, reminds us of the beautiful emerald nickel, (also a hydrocarbonate) discovered by Silliman on the chrome ore, in the serpentine, of Lancaster county, Pa.

The immediate associates of Remingtonite are serpentine, hornblende, epidote, carbonate of lime, and carrollite. The copper mine in which it occurs, is near Finksburg, Carroll county, Maryland, and is under the immediate supervision of Mr. Edward Remington, after whom the species is named.

Philadelphia, May 15th, 1852.

ART. IX.—*Post-Pliocene of the Southern States and its relation to the Laurentian of the North and the Deposits of the Valley of the Mississippi;* by E. DESOR.

THE geologists of the southern United States have designated as Post-pliocene, certain deposits of detrital materials which are seen overlying the tertiary along the coast of Georgia and South Carolina, where they form low and level plains, the average height of which does not exceed twenty feet. According to Mr. Lyell, this formation has an extent of at least 400 miles, it having been traced from the mouth of the Altahamah to that of the Neuse in North Carolina. How much farther it extends to the south along the coast of Florida, has not yet been ascertained.*

As far as their composition goes, these deposits are very homogeneous, generally composed of sand and clay, in regular stratification, so as to convey at once the idea of a prolonged and quiet deposition. In this respect they are essentially different from the coarse drift, and from many of the stratified deposits at the north, which frequently contain scattered boulders, the transportation of which becomes an interesting subject of enquiry.

Here at the south the materials are generally so homogeneous that the question as to their origin does not present itself to the mind, their leading features being derived from their arrangement in layers and from the fossil remains they contain, rather than from the nature, size or form of the materials.

Thus far no attempt has been made to parallelize these deposits with any of the subdivisions of the northern quarternary. Geologists seem in general to have felt satisfied when they could make out that such a deposit was more recent than any tertiary formation; hence the name *Post-pliocene.* Now that we have been enabled to point out several periods in the quarternary epoch, the question arises, to which of these periods the Post-pliocene of the southern states is to be referred, whether to the drift, to the Laurentian, or to the alluvium.

It is not my intention to enter into an elaborate investigation of this problem, which would require more time and labor than I have been able to bestow upon the subject. I shall therefore limit myself to a few suggestions based upon the similarity of the strata and the identity of the fossil shells contained in them.

* From what we know of the structure of Anastasia Island opposite St. Augustine, on the eastern coast of Florida, it appears probable that it belongs to the same formation, the island being composed, according to M. Dietz, of horizontal layers, of a semi-indurated rock consisting wholly of fragments of shells, belonging, as far as examined, almost exclusively to species inhabiting the adjacent coast. The shells are principally of the genus Area; they are *Area pexata*, Say, *A. ponderosa*, Say, *A. incongrua*, Say, *A. transversa*, Say; also *Lutraria canaliculata*, Say, besides a *Mactra*, a *Donax*, a *Crepidula* and a *Lucina*. *Natica*, *Oliva* and *Buccinum trivittatum*, are also mentioned.

The main features of the Post-pliocene of South Carolina are thus defined by Mr. Tuomey.* It is confined to a belt along the coast of about eight or nine miles in breadth. The fossils are nearly all referable to living species now inhabiting the coast; a few however belong to the fauna of Florida and the West Indies. As to its elevation, M. Tuomey† is of opinion that along the whole line of the coast of South Carolina it does not exceed eight feet. "There is no sudden break any where separating it from the beds now in progress of deposition, for it dips gently under the waves of the ocean, and the fossils are often found mingled with living species. So life-like indeed do the shells appear, that it requires the presence of forms no longer inhabitants of the coast, to satisfy one that he is not looking at a recent shell-bed." Like the fossils of the Laurentian along the Kennebec, the shells have even retained their specific colors and markings.

We have already stated, on Sir Charles Lyell's authority, that this formation extends uninterruptedly to the mouth of the Neuse in North Carolina. There indeed, Mr. Conrad long since described a deposit of Post-pliocene, with thirty-four species of marine shells, all identical with those of South Carolina. He found here also the *Gnathodon cuneatus*, a species inhabiting brackish water, together with remains of terrestrial animals.‡

The portion of the coast north of the Neuse, between it and the Chesapeake Bay, bordering on Albemarle Sound and James River, has not as yet been sufficiently examined to allow us to indicate the precise boundaries of the various tertiary and quarternary formations. There is, however, little doubt that the Pine-barrens belong to the most recent deposits; and it would seem that the Post-pliocene occupies here a much wider belt than it does farther south beyond the Neuse.

As to Chesepeake Bay itself, it has been ascertained that the deposits upon its borders belong, partly at least, to the Post-pliocene. As early as 1830, Mr. Conrad called attention to a remarkable deposit of this description at the mouth of the Potomac, which he designated then as upper tertiary.§ The same naturalist published in 1842, in the proceedings of the National Institute, the following list of shells collected there.‖

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* Report on the Geology of South Carolina, p. 212.

† Ibid., p. 188.

‡ Am. Journ. of Arts and Sciences, Proc. of the National Institution, 1842, p. 190.

§ Journal of the Academy of Natural Sciences of Philadelphia, 1830.

‖ It has been a matter of much controversy whether the oyster beds which occur in a sub-fossil state on the Patuxent and in many other places upon the low level plains adjacent to the creeks and rivers along the coast of the middle states, belong to the same formation, as it is supposed by Mr. Conrad, or whether they are due to human agency. As a proof that they were not collected by Indians, it is stated that at the mouth of the Potomac they are covered by the diluvium, which if true would at once settle the question. It is moreover stated by Mr. Conrad that the character and position of these oyster beds is such as to correspond with those of the Gnatho-

Arca transversa, *Say.*
Arca ponderosa, *Say.*
Corbula contracta, *Say.*
Gnathodon cuneatus, *Gray.*
Cytherea Sayana, *Conrad.*
Mactra lateralis, *Say.*
Mya arenaria, *L.*
Mytilus hamatus, *Say.*
Nucula limatula, *Say.*
Nucula acuta, *Conrad.*

Actæon melanoides, *Conrad.*
Crepidula convexa, *Say.*
Crepidula glauca, *Say.*
Fusus cinereus, *Say.*

Pandora trilineata, *Say.*
Petricola pholadiformis, *Lam.*
Pholas castata, *Lam.*
Sanguinolaria fusca, *Say.*
Tellina lusaria (Psammobia lusaria,) *Say.*
Solecurtus caribæus, *Lam.*
Solen ensis, *Lam.*
Venus mercenaria, *Lam.*

Buccinum obsoletum, *Say.*
Buccinum trivittatum, *Say.*
Natica duplicata, *Say.*
Ranella caudata, *Say.*

There is some probability that the regularly stratified beds of dark-blue clay at Baltimore and along the Chesapeake and Delaware Canal, with its beds of lignite and decayed trees, together with the mingled mass of diluvium which reposes upon it, belong to the same formation. We are also inclined to refer to this group the various beds of brilliant sands and dark and white clays which form the banks of the Delaware at and about Bordentown, although we have not as yet heard of any of the characteristic shells having been found in them. The same may be said of the superficial deposits between the Chesapeake and Delaware, which extend over the State of Delaware and a great part of Maryland and New Jersey.

It is not until we reach Long Island that we again meet with fossil remains, (at Brooklyn near New York.) And although the deposits which contain them are somewhat irregular, still the identity of the fossils with others occurring in regular layers both to the north and to the south seems to settle the question of their synchronism.* Indeed we need only to proceed a little farther north, to the Island of Nantucket, to find the same species in an undisturbed condition, forming regular beds and oyster-banks among the stratified layers of clay and sand, as for instance in the cliffs of Sancoti head, where the oysters, the Venus mercenaria, the Serpula and others occur exactly in the same position in which they lived and and died.

On comparing the species from the bluffs of Sancoti head on the island of Nantucket with the above mentioned list from the Potomac or with the list of the Post-pliocene fossils of South Carolina as given by Mr. Tuomey, I find that among the seventeen species which I collected at Sancoti head,† there are but six which do not occur there, viz., *Astarte castanea*, *Cardita borealis*, *Ostrea*

don on the Potomac, which might with just as much reason be referred to Indian agency. Oyster beds of that description occur in Cumberland county, at Egg Harbor on the Severn, at Easton in Maryland, upon the York river in Virginia, and upon various other rivers of the southern states.

* Among the species which I collected at Brooklyn are Venus mercenaria, Mya arenaria, Ostrea borealis, Buccinum undatum, Buccinum trivittatum, all of which occur in the Post-pliocene of South Carolina.

† See the list of the fossils of Sancoti Head, farther below.

borealis, *Buccinum undatum*, *Buccinum plicatum* and *Scalaria groenlandica*, so that it may be fairly assumed as palæontological evidence that the same ocean extended from Georgia and Florida to Cape Cod.

Along this whole coast the Post-pliocene shells, as has already been stated, belong exclusively to recent species, such as now inhabit the neighboring shore. There is, consequently, no proof whatever that the climate was colder than that of the same region at the present day. On the contrary there are positive indications of a milder climate, as was already noticed by Mr. Conrad, who remarked with regard to the Post-pliocene fossils on the Potomac, "the fossils of this locality with two exceptions, are common recent species of the Atlantic coast, and in some instances the original colored markings remain upon the shells. Were it not for the occurrence of *Gnathodon cuneatus*, *Mytilus hamatus* and *Arca ponderosa*, the group would not vary much from that now inhabiting the coast, as far north as Massachusetts; but the presence of these three bivalves indicate that a climate equivalent to that of Florida prevailed, when the shells of this locality were living in the sea."* Mr. Conrad was led to make a similar remark in relation to the fossils of the Neuse, which, with two exceptions, are likewise such as now exist on the coast of the southern Atlantic states and in the Gulf of Mexico. The two exceptions are again *Gnathodon cuneatus* and *Arca ponderosa*.

The island of Nantucket does however not by any means mark the northern boundary of the Post-pliocene fauna. The same species occur farther north, in the vicinity of Boston. A glance at the list of species collected at Sancoti Head (Nantucket) by Mr. Edw. C. Cabot and myself, compared with the list of the species of Point Shirley (Boston harbor) as given by Mr. Stimpson,† will show how clear the resemblance is.

Sancoti Head (*Nantucket*).	*Point Shirley* (*Boston*).
Balanus rugosus.	Balanus rugosus.
Pagurus pollicaris (claws).	Mya arenaria.
Serpula.	Solen ensis.
Mya arenaria.	Mactra solidissima.
Solen ensis.	Venus mercenaria.
Arca transversa.	Astarte sulcata.
Venus mercenaria.	Astarte castanea.
Astarte castanea.	Cardita borealis.
Cardita borealis.	Mytilus edulis.
Ostrea borealis.	Modiola modiolus.
Cumingia tellinoides.	Ostrea borealis.
Crepidula fornicata.	Fusus decemcostatus.
Buccinum undatum.	Buccinum plicosum.
" plicosum.	Buccinum trivittatum.
" trivittatum.	
" obsoletum.	
Scalaria groenlandica.	

* Proceedings of the National Institution, 1842, p. 190.

† Proceedings of the Boston Soc. of Natural History, vol. iii.

A glance at these two lists will be sufficient to show that the formations which contain these shells cannot but belong to the same epoch, however different they may be in structure and materials. Moreover, the fossils of Point Shirley, like those of the Neuse and the Potomac, seem to indicate that the climate was by no means colder, but on the contrary rather warmer than at the present day. There indeed we find in considerable quantity the *Venus mercenaria*, whereas at the present day it occurs but scantily in Massachusetts Bay. So likewise do we find *Buccinum plicosum* among the fossils of Point Shirley, whereas its natural habitat now is south of Cape Cod.

On the other hand, we have shown elsewhere that the resemblance is almost as close between the fossils of Nantucket and Point Shirley on one hand, and those of the valleys of Maine, Lake Champlain and the St. Lawrence on the other. The leading species in both regions are the same, except that a few of the Nantucket species, such as *Venus mercenaria*, *Cumingia tellinoides* and some of the Buccina have disappeared, or are replaced on the St. Lawrence by species which do not occur south of Cape Cod, as for instance, *Cyprina islandica*, *Mytilus edulis*, *Pecten islandicus*, *Saxicava rugosa*. But on the whole the difference is not greater than that which usually occurs between recent species from corresponding latitudes, for instance between a collection of shells from the coast of Maine and one from Long Island or Cape Cod.

As far as palæontological evidence goes, there seems to be sufficient reason to consider the Post-pliocene of the south as the equivalent of the Laurentian of the north. There is moreover evidence enough to warrant the conclusion that at the time of their deposition, the climate, far from being colder, was *throughout* warmer than at the present day.

There are nevertheless some striking differences between the Post-pliocene of the south and the Laurentian of the north, which deserve to be considered.

First, the Laurentian deposits of the north occur at much higher levels than the pliocene of the south. We have stated before on Mr. Tuomey's authority, that on the whole coast of South Carolina the average height of the pliocene does not exceed eight feet; and, according to Mr. Lyell, its elevation along the whole coast from Georgia to North Carolina is less than twenty feet. At Nantucket, on the contrary, the fossil oyster bank occurs at a height of thirty feet; which is also the elevation at which the Venus mercenaria and other species are found at Point Shirley. At Brooklyn near New York, they exceed 100 feet in height. Their elevation at Augusta on the Kennebec is about 70 feet. At Lake Champlain they occur at 200 feet. At Moira on the Northern railroad they are found at 310 feet; at the mouth of the

St. Lawrence they reach a height of 390, and at Montreal as much as 470 feet. It is evident therefore, that the changes of level by which the shells were raised to their actual position in these various localities must have embraced a much wider range at the north than at the south.

Another and more striking difference between the two deposits is afforded by the erratic boulders. It is well known that over all New England and the greater part of New York, including Long Island, there occur a quantity of boulders scattered over the surface or buried within the detrital formations; and moreover these boulders can all be traced back to some northern origin more or less remote, showing that they have travelled from north to south. But in proceeding farther south, they vanish gradually. There are very few in the vicinity of Philadelphia and Baltimore, or if they occur occasionally, as for instance along the Potomac at Washington and in the neighborhood, they are of a different kind and can be traced to some rock within the Alleghanies. Some of them contain even fossils characteristic of formations which occur beyond the Blue Ridge.

Proceeding still farther south, to North and South Carolina, we lose sight of the boulders entirely; Mr. Conrad states that he never saw a single boulder on the surface of the state of Alabama. But the stratified deposits with which they are associated at the north continue uninterruptedly. It is indeed not a little remarkable that the only difference which M. Tuomey recognizes between the Post-pliocene and the diluvium consists in the absence of boulders in the former. "I have," says he, "nowhere in the state (South Carolina) seen one (boulder) a foot in diameter, nor have I met with a single bed that I could refer to this formation (diluvium) along the tertiary plane from the Mississippi to the Potomac."* The same author adds that, as we proceed southwards, the "materials become finer and finer. The large pebbles are succeeded by gravel and coarse sand, and towards the coast they are replaced by the fine sands blown about by the winds."

The question then will be asked how it happens, that both formations (Laurentian and Post-pliocene) being contemporaneous, the one contains boulders, whilst the other contains none? Was there some barrier which prevented the northern boulders from proceeding farther south than New York and New Jersey? And if such a barrier existed, why do we not find any trace of it? Or do the last boulders about New York indicate that the agency by which they were transported had exhausted its power? But in that case they ought to decrease in size from north to south whereas we know that the boulders on Long Island are as voluminous and heavy as those occurring farther north through-

* Ibid, p. 189.

out New England and Canada. Geologists have proposed various solutions of this great problem. To examine them all would lead us far beyond our limits. I shall therefore merely allude to some of the theories, and point out the characteristic features of each.

The most ancient theory, and at first sight the most simple, is that which ascribes the transportation of the boulders to a violent action of the waters, progressing from north to south either in form of currents (according to Sefström, von Buch, Elie de Beaumont) or in form of earthquake waves (according to Profs. Rogers), such as are sometimes known to sweep over the islands of the Pacific and to cover them with debris. In each of these hypotheses it is assumed that the momentum of the current or earthquake wave went on decreasing gradually and that the limits of the boulders mark the place where its power of transportation became exhausted. This explanation appears indeed to be borne out in various localities of the interior of the country, as was pointed out by us elsewhere.* But there is this objection to its application to the littoral regions under consideration. It must be assumed, in accordance with the well known facts, that wherever a transportation by water takes place, there is a constant relation between the size of the materials and the momentum of the transporting current or wave; the former decrease in size and weight in proportion as the force by which they are impelled decreases. Now such is not the case on Long Island, Martha's Vineyard, Nantucket and along the coast of New Jersey. There the materials are generally finely comminuted and regularly stratified, indicating at the first glance that they have been deposited in a quiet manner. On the surface of these strata of fine sand we find the boulders scattered here and there, generally on the prominent points, as for instance on the island of Nantucket, and generally as large if not larger than those farther north. In such cases, it is obvious that no theory depending on aqueous currents can be sufficient to account for the phenomena.

Another theory which has had some currency, is that which ascribes the transportation of boulders to the former existence of gigantic glaciers, covering the northern hemisphere and extending as far south as the latitude of New York. It is supposed in this theory that the boulders were transported on the surface of the glaciers, and the underlying masses of sand and gravel were considered as the remains of the bottom moraines. The circumstance that the southern limit of the large boulders coincides pretty nearly with that of the ground and polished rocks seemed at first to confirm this view, and it seemed fair to assume on that

* Foster and Whitney's Report on the Geology of the Lake Superior Land District.

ground that the boulders did indeed indicate the limits of the ancient glaciers. On closer examination it was found, however, that the glacier theory could not apply to the region under consideration, in as far as the materials which underly the boulders are not only stratified, but moreover contain a quantity of fossil remains, which indicate that a considerable amount of time must have elapsed between the furrowing of the rocky floor and the transportation of the surface boulders. Now if the furrows and scratches have been made by glaciers, it is evident that the boulders resting on the surface of the stratified sand must have been transported at a much later period. In the glacier theory of M. de Charpentier (which is also advocated by M. Agassiz) it is assumed on the contrary that the furrowing of the rock and the transportation of the boulders are simultaneous, that they are the result of the same agency.*

The third and most popular theory is that which ascribes the transportation of the boulders to the agency of ice rafts. When we consider the striking contrast which exists between the size of the boulders and the minuteness of the materials on which they rest, which excludes all idea of their having been assorted, and consequently of all violent action, there is indeed sufficient reason to look upon this theory as the best adapted to solve the problem. Supposing the boulders to have been packed in ice which was driven by wind and current from north to south along the coast, it seems natural that these rafts should have been stranded upon the prominent points of the coast and adjacent islands which at that time were shoals, dropping there their burden of boulders.

There is, however, a difficulty even in this theory, viz., the circumstance that the ice-rafts must have reached frequently as far south as New York, whereas at the present day it is very seldom that they are driven as far south.† To assume that the boulders on Long Island and the coast of New Jersey were transported on ice-rafts would therefore be tantamount to assuming that the climate was colder than at the present day. And yet we have the testimony of the shells buried underneath the boulders to show that far from being colder, the climate was rather warmer. An explanation of this difficulty may perhaps be found in the fact that the greater part of the boulders overlie the fossils

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* Whether the furrowing and polishing of the rocks is really the result of glacier action, and whether the materials of the stratified clay, sands and gravel-deposits were *first* transported by glacier and *afterwards* merely displaced and rearranged, are questions which I do not intend to discuss at present. My object here is merely to prove that the boulders could not have been brought into their *actual* position by glaciers.

† A few icebergs have been seen as far south as New York, but, as far as I know, no field-ice.

and are therefore referable to a later period in which the climate may actually have been colder. This however is a mere hypothesis.*

The foregoing remarks apply more especially to the boulders along the sea-shore from New England to Long Island and part of New Jersey. From all the evidence we possess it seems highly probable that they were transported on ice-rafts along the sea-shore and stranded on the ridges and eminences which were then shoals along the coast. The next question then is, whether this mode of transportation applies likewise to the boulders occurring in the interior of New York and Pennsylvania, or whether we have to look for another agency?

It has been stated before that the last boulders of northern origin occur in New Jersey, a little south of New York. But according to Prof. H. D. Rogers, they are chiefly limited to the sea-shore, and it would appear as if the highlands of New Jersey had acted as a barrier, preventing them from spreading south, except through the channels of the rivers. Indeed there can be no doubt that the few boulders in the neighborhood of Philadelphia are confined to the valleys, and on ascending the uplands in the neighborhood of the city we find that they disappear. The valley of the Delaware was such a channel by which a few northern boulders were conveyed farther than they would otherwise have reached.

The valleys of the Susquehanna and the Potomac contain also a great many boulders, but those of the latter, it seems, are without exception derived from the Appalachian chain itself, whereas among those of the Susquehanna, there may be some of northern origin intermingled with those of the neighboring mountain. According to Prof. H. D. Rogers, there are evidences in each of these valleys of a violent rush of waters, which is supposed to have carried along with it the boulders which the valleys contain. But whether the same can be said of the boulders occurring at a distance from the mountains, as for instance those in the neighborhood of Washington, seems to us rather doubtful; for in leaving the gap of the Blue Ridge, the current would necessarily have abated and it is difficult to conceive how it could have borne along the same boulders over an almost level country as far as Washington. Indeed we need only to look at the position in and about the last named city, to be convinced that they cannot but have been transported by the same agency which transported those of Long Island, viz., by floating ice. The materials accompanying them moreover confirm this.

* It might perhaps be assumed on hygrometric principles, that the area of water being greater at the time of the transportation of the boulders, there was a greater amount of evaporation causing more moisture and consequently more snow and ice.

The absence of boulders constitutes, however, not the only difference between the Post-pliocene of the South and the Laurentian of the North. Whilst the latter is an exclusively marine formation, the Post-pliocene is said to contain besides remains of land and freshwater animals. M. Tuomey mentions in the Post-pliocene of South Carolina some bones (in a bed of mud on Edding's island) which he is inclined to refer to the Megatherium. M. Conrad, speaking of the deposits on the Neuse of North Carolina, says that they are "of more than common interest in consequence of the quantity of bones of land animals which are mingled with the shells."* According to Sir Ch. Lyell, the Post-pliocene of Georgia contains, besides the marine shells, some beds filled with freshwater shells which are said to be identical with species living actually in the neighborhood. It is farther stated that the same freshwater beds contain remains of many land animals, among them, bones of Mastodon,† Elephas, Mylodon, Megatherium, horse, ox and Harlanus, a peculiar genus allied to Lophiodon. It is moreover stated by Sir Ch. Lyell that the bones, especially those of Megatherium, are by no means injured and their position is such as to convey the idea that whole skeletons must have been floated by a river to the place where they are found buried. On the strength of these statements it has been taken for granted that the above named quadrupeds must have lived *during the Post-pliocene period.*

Now if it be true, as we have endeavored to prove, that the Post-pliocene and Laurentian are parallel formations, it would follow that the mastodon and its kindred existed on this continent at the time of deposition of the Laurentian of the North. Such an inference, however, would conflict with our knowledge of the position of mastodon remains throughout the northern states, where they have never been found in the Laurentian, but occur invariably in deposits of a more recent date, such as river terraces, peat-bogs, &c.

Before taking it for granted that the deposits containing bones of mastodons and elephants in Georgia are really Post-pliocene, it might be well to inquire whether they may not belong to a later epoch, as the very suggestion of Lyell, "that the skeletons must have been floated by rivers," seems to imply. We might, in like manner, point out various localities at the north where mastodons were said to occur *in the drift*, but which, after closer examination, were found to belong invariably to a more recent epoch.

The remarks of M. Tuomey respecting the bones mentioned by him among the Post-pliocene fossils of South Carolina, "that

* Proceedings of the National Institution, 1842, p. 191.

† M. Tuomey mentions also the same elephant in the pliocene of South Carolina.

they occur in a bed of mud," seems also to justify the supposition that they may belong to a later period.

On the other hand, we know that the remains of mastodon and elephants are found associated with land and freshwater shells in the bluffs of the lower Mississippi, and that on that account these bluffs have been parallelized by geologists with the river terraces of the North which we know to be more recent than the Laurentian and to belong to the alluvium. Should it be proved that the deposits with mastodon bones throughout the states of Georgia and South Carolina do not belong to the true Post-pliocene, but are, like those of the North, of a more recent origin, there would no longer be any difficulty in the way of identifying the Laurentian and the Post-pliocene as one and the same formation, whereas the beds containing mastodons at the South, together with the river terraces of the North and the valley drift of the West, including the loam bluffs of the Lower Mississippi and the celebrated deposits of Big-Bone Lick, would represent another more recent period, *that of the alluvium*, which passes gradually into the historical period, if it does not actually belong to it.

But should it ever be shown that the mastodon remains of the state of Georgia are really associated with true Post-pliocene shells, it does not by any means follow that it would contradict our views as to the parallelism between the Laurentian of the North and the Post-pliocene of the South. The question might then be asked whether the absence of remains of land animals at the North could not be accounted for, merely by supposing that the changes of level which were going on at that time were too considerable, and the extent of dry land at the time of the greatest depression of the Laurentian sea too small to support such huge animals, whereas the extensive tertiary plains of the southern states, which were then dry land, might well have afforded a convenient home for them. In this case it would appear that they subsequently migrated to the North, where at the beginning of the alluvial period, the area of dry land began to be sufficiently extensive.

These are problems which are well worthy the attention of American geologists.

ART. X.—*Mineralogical Notices;* by Prof. MENEGHINI of Pisa.*

* * * PROFESSOR C. BECHI, one of my friends, is about publishing some analyses of Tuscan minerals in our official report, and as they will be nearly lost to science in the large volume, I take the liberty of transcribing for you in brief, our observations. The analyses are by Prof. Bechi.

Galena.—Of the following galenas, No. 1, is a coarse granular variety from Bottino near Seravezra; 2, 3, fine granular, from the same locality; 4, fine granular from Argentiera in Val di Castello; 5, octahedral crystals (Jargionite of M. Bechi) from the same locality.

	S	Pb	Sb	Fe	Cu	Zn	Ag	
1.	12·840	80·700	3·307	1·377	0·440	0·024	0·325 =	99·013
2.	15·245	78·238	4·431	1·828	trace	——	0·485 =	100·227
3.	15·503	78·284	2·452	2·811	——	——	0·560 =	99·610
4.	16·780	72·440	4·308	1·855	4·251	——	0·650 =	100·284
5.	15·62	72·90	5·77	1·77	1·11	1·33	0·72 =	99·22

The last variety appears to resemble Bleischweif and is probably identical with *Steinmannite.* Its specific gravity is actually 6·932.

Fahlerz in fine crystals is found at Angina, Val di Castello. Analysis (agreeing closely with that by Kersten),

S	Sb	Cu	Zn	Hg	Fe	Ag	
24·1413	26·5240	37.7172	6·2311	3·0313	1·6360	0·4500 =	99·7309

Feather ore (*Heteromorphite*), *Boulangerite, Jamesonite* and *Meneghinite* from *Bottino.* Analyses:

	S	Sb	Pb	Cu	Zn	Fe	
1. Capillary Heteromorphite,	18·395	30·186	47·681	1·110	1·085	0·255 =	98·712
2. Acicular "	19·250	29·244	49·311	2·000	0·211	—— =	100·016
3. Massive Boulangerite,	17·994	26·085	53·154	1·242	1·407	0·350 =	100·232
4. Acicular "	17·822	26·740	55·390	1·250	0·085	0·230 =	101·517
5. Capillary Jamesonite,	20·5335	32·1576	43·3830	1·2453	1·7356	0·9450 =	100
6. Meneghinite,	17·522	19·284	59·214	3·540	——	0·344 =	99·904

A third variety of the *Boulangerite* is fibrous compact. These three forms are very distinct, and the last perfectly resembles Zinkenite; the analyses conduct closely to the Boulangerite formula, $3PbS+SbS^3$. The external characters of the *Jamesonite* are those of Heteromorphite, but the analysis gives the formula of Jamesonite $3PbS+2SbS^3$, as deduced by M. Bechi.

The *Meneghinite* is a new species, established by M. Bechi. It occurs in compact fibrous forms, very lustrous: H.=2·5. The analysis leads to the formula $4PbS+SbS^3$, a compound hitherto unnoticed.

* From a letter, to J. D. Dana, dated Pisa, March 10, 1852.

Copper glance (Chalkosine, *Beud*).—Analyses:—

		S	Cu	Fe	
1.	Monte Catini,	20·50	76·54	1·75 =	98·79
2.	"	17·631	63·864	2·426, Fe 15·750, =	99·671
3.	Monte Vaso,	15·734	58·500	1·450 " 24·125, gangue 0·125 =	99·934
4.	"	15·480	57·785	1·333 " 25·000	
5.	S. Biagio,	24·5249	40·8925	15·8282 —— gangue 17·9350 =	99·1806
6.	"	15·9771	31·4370	8·8559 —— " 42·1195 =	98·3895

The last two analyses are only of metallurgical interest, as the copper glance was mixed with copper pyrites. The oxyd of iron in the three preceding, is evidently a mechanical mixture.

Chalcopyrite or Copper pyrites, and Erubescite.—Analyses:

		S	Cu	Fe,	Gangue.	
1.	Chalcopyrite, Castellina Marit.,	30·072	27·540	38·800	3·450 =	99·862
2.	" Les Capanne Vecchie,	30·348	18·008	43·336	8·624 =	100·316
3.	" Val Castrucci,	35·617	34·091	30·292	—— =	100·000
4.	" Ferriccio,	41·306	15·960	38·484	4·250 =	100·000
5.	" Mt. Catini,	36·155	32·788	29·750	0·863 =	99·556
6.	" Riparbella,	30·092	27·540	38·832	3·250 =	99·714
7.	" Campiglia,	34·030	31·300	34·670	—— =	100·000
8.	Erubescite, Mt. Catini,	24·926	55·880	18·028	—— =	98·834
9.	" "	23·363	59·472	13·868	0·750, Fe 1·500 =	98·953
10.	" "	23·415	59·672	13·868	2·687 =	99·642
11.	" Miemo,	23·983	60·160	15·088	—— =	99·231
12.	" Ferriccio,	24·700	60·007	15·889	—— =	100·596
13.	" Castagno,	24·108	52·288	18·192	4·748 =	99·336
14.	" Rocca a Sillano,	20·015	46·700	13·700	18·350 =	98·765
15.	" L'Impruneta,	21·044	46·300	15·600	16·500 =	99·444
16.	" Mnte Castelli,	22·031	58·276	12·134	7·560 =	100·001
17.	" Les Capanne Vecchie,	18·088	45·130	11·125	25·750 =	100·093

The analyses of chalcopyrite appear to lead to the formula in which the proportions of the two sulphurets are variable, e. g. $4Cu^2S+5Fe^2S^3$, $Cu^2S+3Fe^2S^3$, etc. Those of Erubescite seem to establish for the species the single formula (Fe, Cu)S, instead of several formulas containing the two sulphurets in various proportions.

Zigueline.—Analyses:

		O	Cu	
1.	From Les Capanne Vecchie,	11·22	88·78	
2.	" Elba,	10·88	86·12	mixed with native cop. 3·00 = 100

The Elba zigueline is crystallized in cubes, and frequently with pseudomorphs of malachite.

White Antimony.—It occurs at Pereta with Stibine in small acicular crystals. Analysis:—

O	Sb	Fe	Gangue.
19·470	78·830	1·250	0·750 = 100

Marmatite.—Found at Bottino near Serravezra, well crystallized in tetrahedrons and also massive.

1.	In tetrahedrons,	S 32·117	Zn 50·901	Fe 11·441	Cd 1·226	FeS^2 0·750 = 96·435
2.	massive,	33·653	48·110	16·232	Cu and Cd *traces*	= 97·995

The formula is 4(Zn, Cd) S + Fe S, or (Zn, Cd, Fe) S.

Oxyd of Zinc.—Occurs on the marmatite. Composition,

Zn O 31·725 Ḟe 47·450 Ḣ 20·825=100

It is evidently a mechanical mixture, and the oxyd of iron may be derived from the Franklinite mixed with the oxyd of zinc.

Braunite.—A compact variety from the island of Elba afforded: O 3·080, Ṁn 88·310, Ḟe 4·750, Ḃa 1·025, S̄i 0·751, Ḣ 2·084=100, =Mn O+Mn O³

Chromic Iron from near Volterra. Analysis:—

C̄r 42·130 Ḟe 33·933 S̄i 4·750 Ā1 19·835=100·648

Silicated Chrome (Wolchonskoite?):

S̄i 28·357 C̄r 8·112 Ā1 41·333 Ḣ 22·750=100·552

An argillaceous earth containing oxyd of chrome occurring near Volterra afforded,

Ā1 63·158 Ḟe 8·183 C̄r 5·770 S̄i 5·925 Ḣ 19·266=102·302

The point of especial interest connected with these three minerals is, that they have originated from the decomposition of the diallage of Euphotide. All the transitions from the diallage to the chromic ochre may be traced out. The chromic iron forms seams which thin out downward. The metamorphosis seems to have been due to ancient sulphur exhalations, ("Soffione,") traces of which are still seen in places even now emitting vapor and incrusted about with chalcedony.

I am also indebted to my friend, Prof. Bechi, for several analyses of silicates from the Gabbro rosso.

Caporcianite.—Monoclinic; the forms are referable perfectly to Heulandite and are very near that species in the angles; M : T = 131°, M : T on ā = 150°. Cleavage extremely easy parallel to P and T, and easy also parallel to M: with a light shock the crystals fall to acicular fragments. Also in macles, and imperfectly radiated foliaceous. H. = 3·5. G. = 2·470. Color flesh-red; lustre pearly. Faces M minutely striated. Only the smallest fragments transparent. Composition:

S̄i Ā1 Ċa Ṁg K̇ Ṅa Ḣ

52·015 22·833 9·675 1·114 1·112 0·250 13·168=100·197

Formula, 2Ċa S̄i+Ā1² S̄i³+6Ḣ. The analysis agrees quite nearly with that by Anderson, and we might deduce from it the other formula, Ċa² S̄i³+2Ā1 S̄i+6Ḣ, which, however, is much less accordant with analogies. Dissolves easily in acids and forms a jelly even in the cold. The solution gives a precipitate with oxalate of ammonia. Heated in a glass tube, yields water. B. B. fuses to a white enamel without intumescence. It occurs in geodes incrusted with crystals of calcite in the Gabbro rosso of Mt. de Caporciano at L'Impruneta and several other places; and sometimes it is accompanied by native copper.

Picranalcime.—Monometric; trapezohedral and cubo-trapezohedral. Cleavage cubic, very distinct. H. = 5. G. = 2·257.

Lustre vitreous; colorless to flesh-red and colophonite-red. Composition:

	$\dot{S}i$	$\dot{A}l$	$\dot{M}g$	$\dot{N}a$	$\dot{K}$	$\dot{H}$
1.	59·347	22·083	10·250	0·450	0·015	7·650=99·795
2.	58·875	22·083	10·000	0·450	0·015	7·688=99·111

Oxygen ratio 1 : 3 : 8 : 2, like analcime. Formula, $(\dot{M}g, \dot{N}a, \dot{K})^3\dot{S}i^2+3\dot{A}l\,\dot{S}i^2+6\dot{H}$= (supposing the protoxyds magnesia alone) $\dot{S}i$ 57·96, $\dot{A}l$ 24·14, $\dot{M}g$ 9·41, $\dot{H}$ 8·22 = 99·73. The formula $2\dot{R}^3\,\dot{S}i^2+5\dot{A}l\,\dot{S}i^2+10\dot{H}$ would correspond to $\dot{S}i$ 58·43, $\dot{A}l$ 23·05, $\dot{M}g$ 10·71, $\dot{H}$ 8·08=100·27; but the preceding is to be preferred. Dissolves in the acids, and the solution gives with potash a flocculent precipitate which moistened with nitrate of cobalt and heated, becomes of a blue color. In a closed tube gives water. B. B. fuses with difficulty. Covers the interior of geodes in the Gabbro rosso, or the surfaces of contact between the Gabbro and the Ophiolite, sometimes having a metallic nucleus and enveloped in the steatitic paste of the metalliferous dyke. Often accompanied with Calcite, Caporcianite and Picrothomsonite.

Picrothomsonite.—Trimetric. Mass radiated in one direction, and in a direction normal to this laminated according to two cleavage directions equally easy parallel to $\dot{M}$ and $\breve{M}$. H. = 5. G. = 2·278. Lustre pearly; white; transparent in small fragments; very fragile. Composition:

$\dot{S}i$	$\dot{A}l$	$\dot{C}a$	$\dot{M}g$	$\dot{N}a, \dot{K}$	$\dot{H}$
40·356	31·251	10·993	6·265	0·285	10·790=99·940

Formula $2\,(\dot{C}a, \dot{M}g)^3\dot{S}i+5\dot{A}l\,\dot{S}i+9\dot{H}$=$\dot{S}i$ 40·08, $\dot{A}l$ 31·83, $\dot{C}a$ 10·55, $\dot{M}g$ 7·58, $\dot{H}$ 10·00=100·04. It differs a little from that of Thomsonite, in having the ratio of the protoxyd and peroxyd silicates 2 : 5 instead of 2 : 6, and in the proportion of water also being a little smaller. Dissolves even in cold acids and gelatinizes, and the solution is precipated by oxalate of ammonia. In a tube yields water. B. B. fuses to a white enamel with intumescence. Occurs with Picranalcime and Caporcianite in the Gabbro rosso.

Portite, (a new species dedicated to M. Porte, "qui a fait renaitre l'art minéraire en Toscane").—Trimetric; in radiated masses, with cleavage very distinct parallel to the faces of a rhombic prism of about 120°. H = 5. G = 2·4. White; opaque; lustre vitreous. Composition:—

$\dot{S}i$	$\dot{A}l$	$\dot{C}a$	$\dot{M}g$	$\dot{N}a$	$\dot{K}$	$\dot{H}$
58·125	27·500	1·759	4·873	0·157	0·100	7·917=100·431.

Formula $(\dot{M}g, \dot{C}a)^3\dot{S}i^2+4\dot{A}l\,\dot{S}i^2+7\dot{H}$=$\dot{S}i$ 58·36, $\dot{A}l$ 25·95, $\dot{M}g$ 7·71, $\dot{H}$ 7·95. The resemblance of this formula to that of Harmotome will be noticed, and also to that of Phillipsite. We might almost consider it a magnesian harmotome; yet there is too large a difference in the proportion of water, which, I believe, justifies giving it a different name. Dissolves in acids even in the cold, and gelatinizes. The solution whitens slightly when gently heated with

oxalate of ammonia and affords but a very small precipitate with potash. In a closed tube yields water. B. B. intumesces much and affords a milk-white enamel.

Sloanite.—Occurs with the preceeding. Trimetric; and in radiated masses with very distinct cleavage parallel to all the faces of a rhombic prism; M : M = 75° and 105°. H = 4·5. G = 2·441. White; opaque; pearly; transverse fracture irregular, but frequently in a plane at right angles to the radiation of the prisms. Composition :—

$\ddot{S}i$	$\dot{A}l$	$\dot{C}a$	$\dot{M}g$	$\dot{N}a$	$\dot{K}$	$\dot{H}$
42·187½	35·000	8·119	2·670	0·250	0·030	12·500 = 98·756½

Formula $(\dot{C}a, \dot{M}g)^3\ddot{S}i^2 + 6\dot{A}l\,\ddot{S}i + 12\dot{H} = \ddot{S}i$ 42·47, $\dot{A}l$ 35·41, $\dot{C}a$ 9·69, $\dot{H}$ 12·41. The formula is analogous to that of the other zeolites (Mesole, Brevicite, Liebnerite, etc. ;) and also to species out of this group, excepting the water, such as Rosite and Polyargite. I have named this species after Mr. Sloane, proprietor of the mine of Mt. Catini. Dissolves in the acids, even in the cold, and gelatinizes, and the solution is precipitated by oxalate of ammonia. In the closed tube yields some water. B. B. fuses without intumescence to a white enamel.

Schneiderite.—Occurs with the preceding, in the Gabbro rosso, along with Humboldtite (?). Mass confusedly laminato-radiate; white; opaque. H = 3. Composition :—

$\ddot{S}i$	$\dot{A}l$	$\dot{C}a$	$\dot{M}g$	$\dot{K}$ & $\dot{N}a$	$\dot{H}$
47·794	19·382	16·765	11·029	1·621	3·409 = 100.

Formula, $3(\dot{C}a, \dot{M}g)^2\ddot{S}i^2 + \dot{A}l^6\,\ddot{S}i^3 + 3\dot{H} = \ddot{S}i$ 45·98, $\dot{A}l$ 19·16, $\dot{C}a$ 31·49, $\dot{H}$ 3·35. I have proposed this formula with much hesitation, finding no like compound among the known zeolites; the species is named after M. Schneider, director of the mine of Mt. Catini. Dissolves in acids, even in the cold, and gelatinizes, and the solution is precipitated by oxalate of ammonia. In a closed tube yields water. B. B. fuses with intumescence to a blue enamel.

Savite.—Dimetric. In acicular rectangular prisms, a centimeter long, very slender, terminating in pyramids or truncated; radiating; colorless; transparent. H = 3·2. G = 2·450. Composition :—

$\ddot{S}i$	$\dot{A}l$	$\dot{M}g$	$\dot{N}a$	$\dot{K}$	$\dot{H}$
49·167	19·663	13·500	10·520	1·230	6·575 = 100·675.

Formula, $(\dot{M}g, \dot{N}a)^3\,\ddot{S}i^2 + \dot{A}l\,\ddot{S}i + 2\dot{H} = \ddot{S}i$ 49·555, $\dot{A}l$ 18·364, $\dot{M}g$ 14·564, $\dot{N}a$ 11·079, $\dot{H}$ 6·438. We might deduce $(\dot{M}g, \dot{N}a)^3\,\ddot{S}i + \dot{A}l\,\ddot{S}i^3 + 2\dot{H}$, and there are some analogies for it as well as for the other. The oxygen ratio for the protoxyds, peroxyds, silica and water, 1 : 1 : 3 : $\frac{2}{3}$, is new; and I trust the species may prove to be well-grounded, and worthy to bear the name, justly famous, of M. Savi. Soluble in the acids; the solution gives with potash a flocculent precipitate, which affords a blue color when moistened with

nitrate of cobalt and heated. In a closed tube yields water. B. B. fuses with great difficulty. Occurs with Picranalcime in the Gabbro rosso.

Humboldtite, (Datholite.)—Monoclinic, and apparently like the figures of Levy. Composition:—

$\ddot{S}i$	$\dot{A}l$	$\dot{C}a$	$\dot{M}g$	$\ddot{B}$	$\dot{H}$
37·500	0·852	35·341	2·121	22·033	1·562=99·413.

Formula, $2(\dot{C}a^3\ddot{S}i^4+3\dot{C}a\ddot{B})+\dot{M}g\dot{H}^2=\ddot{S}i$ 38·75, $\dot{C}a$ 35·36, $\ddot{B}$ 21·93, $\dot{H}$ 1·87, $\dot{M}g$ 2·09. The mineral of the Seisser Alp gives the same composition. Dissolves in the acids, forming a jelly, and oxalate of ammonia gives an abundant precipitate, which dried, dissolved in alcohol, and inflamed, affords a flame colored green on the borders. B. B. fuses very easily. Occurs with Schneiderite, in the same manner as at the Seisser Alp, associated with Apophyllite in geodes in the Gabbro Rosso.

Art. XI.—*Notice of A. Quekett's Practical Treatise on the use of the Microscope.**

The first edition of Mr. Quekett's work appeared at a time when there was a general dearth of books on practical microscopy. With the exception of the small works of Chevalier, Dr. Goring and Mr. Pritchard, all of which were written with a view to praise and sell the microscopes of their own construction, and in which the least possible amount of practical information was introduced, no book of any note or character had been for a long time published. In this lapse of time it was evident that microscopy had made considerable progress, and some work was needed, in which this progress would be faithfully detailed, as an assistance to those who were already workers in the field and as a guide to those who desired a practical acquaintance with the subject, and were unable to obtain the necessary information.

Mr. Quekett's work, evidently the result of much practical knowledge, was therefore warmly welcomed, and the rapid sale of the entire edition, has proved abundantly that the book was both needed and appreciated.

With all its value however, it had, as a general practical work, some important faults: many of omission and some of commission; these it was hoped and believed would be rectified in the second edition, which comes to us "with numerous additions,"

* A Practical Treatise on the use of the Microscope, including the different methods of preparing and examining animal, vegetable and mineral structures; by John Quekett, Assistant Conservator of the Museum, and demonstrator of minute anatomy at the Royal College of Surgeons of England. Second edition, with additions, illustrated with 12 plates, and 270 wood engravings. London: H. Balliére, 219 Regent St., and 290 Broadway, New York. 8vo, pp. 515. 1852.

and the hope on the author's part that the present volume "will be found more worthy of notice."

In the brief space to which we are limited we can only examine the points of difference in the two editions.

The second edition contains fifty-one pages, three plates, and twenty-nine wood engravings not in the former one. The general plan of the book is unchanged.

To the history of the microscope, and the chapter on the simple microscope, nothing has been added. The chief part of the chapter on compound microscopes is devoted to the description of the instruments made by Ross, Powell and Lealand, and Smith and Beck. These descriptions have the same fault as was generally complained of in the first edition: the author does not proffer any advice, as to which form he has found to have the most advantages and fewest defects. In this chapter we have mention of a new London maker, Mr. Pillischer; also of Mr. King of Bristol and Mr. Abrahams of Liverpool. These three, however, receive but faint praise, though "report speaks well" of Mr. Abrahams.

Following this we have a description of "foreign microscopes," occupying nine pages, including five large figures. The want of information about other instruments than those of London make, was justly complained of as a prominent fault in the first edition. This seems to have been represented to Mr. Quekett, who however does not admit that it was a fault, if we may judge from the preface to the present volume. "It having been objected, that no mention was made of foreign microscopes in the first edition, this seeming omission is remedied by the description of all the best instruments now manufactured by our continental neighbors." This description however, so unwillingly given is miserably meagre, and we believe by no means does justice to the opticians whose instruments are noticed. We can here only allude to two of them, M. Oberhauser, and M. Nachet of Paris.

The instrument of M. Oberhauser, "for general purposes," figured at page 107, is a deformed little microscope, with a compound body of about five inches in length, if the figure be rightly proportioned, and the fine adjustment placed on the top of the arm which supports the compound body. This is described as a sample of the Oberhauser microscope. The figure is little less than a libel, and we venture to assert that Oberhauser has not made such an instrument within the last five years. We have seen many of his microscopes in private hands and on sale, and we never saw one answering to the description here given. In a foot-note we are informed, as the latest information in regard to Oberhauser's microscopes, that he "has placed the fine adjustment at the bottom of the support of the compound body instead of at the top. He has also increased the length of the compound

body." This is as he has made them for the last five years to our certain knowledge, and perhaps longer. Not a word about his improvements within the last year or two, of his new "horse-shoe stand," moveable mirror for obtaining oblique light, &c., and yet some instruments of this form have reached this country.

So with regard to Nachet's microscopes: the one figured and described (p. 108) is one of Nachet's more common and cheaper forms. No allusion to his inclined microscope, which allows, even when inclined, the body and stage to be revolved on their support, and not a single word of commendation for his objectives, which will favorably compare with those of London make, and are furnished at about one-fourth the price. These descriptions are therefore both imperfect and unjust.

Under the head of foreign instruments we should have been justified in expecting to find some notice of American microscopes, particularly those of Mr. Spencer's construction, and this especially as the first edition of Mr. Quekett's work contained a slighting notice of Mr. Spencer, and an imputation upon the correctness of his description of the then new test, Navicula Spencerii, which we should have thought Mr. Quekett would have been glad to have corrected. But Mr. Spencer's name has been altogether suppressed, the full-length imaginary portrait of the Nav. Spencerii as "faithfully delineated" by Mr. Warren De la Rue, who discovered "depressions or perforations" where none existed, is omitted, and were it not that in the list of test-objects furnished by Mr. Topping, the N. Spenceri appears, shorn of its Latinity, we should have no knowledge that any such optician ever existed. And yet it is a matter of record that the humble little shell which bears his name, from his having first resolved it with his own lenses, puzzled the bravest of the English microscopists for several weeks, after it had been thoroughly resolved on this side the Atlantic. We say that we might have expected some notice of Mr. Spencer in the list of the "principal foreign" microscope makers, but the meagre account given of other principal makers reconciles us to the omission.—Mr. Spencer has been guilty of the unpardonable fault of teaching English opticians something—that 135° was not the "largest angular pencil that can be passed through a microscopic object-glass," (1st ed. p. 431,) but that it might be increased to 160°, and lately even to 174½°; that there were more difficult test-objects than the Podura scales and Nav. angulata, the latter of which is still recommended as a good test for "an $\frac{1}{6}$th or $\frac{1}{12}$th" (2d ed. p. 394) and then "generally mounted dry"! (p. 411)—and that lines closer than the $\frac{1}{18000}$ of an inch apart, were by no means "near to the utmost limit that the position of a line can be ascertained." (1st ed. p. 442.) For these and similar offences, Mr. Spencer's name and occupation have been suppressed.

The chapter on magnifying powers closes the first part of the book, which we cannot pass over without congratulating Mr. Quekett on the correction of the egregious blunder contained in the 1st edition in two places, pp. 73 and 160, that when the Ramsden eye-piece is used, "the image of the object is not reversed as in the Huyghenian form: hence it has received the name of a positive eye piece." We observe it stated that "the whole of the former edition" has been revised by Mr. Lister and Mr. Jackson.

The several chapters on the Use of the Microscope, we are obliged to pass over entirely, merely remarking that they seem to be more complete, than the corresponding chapters in the first edition: we are glad to see that Mr. Goadby justly receives more credit for his methods of preparing and mounting objects, than was previously accorded to him.

Mr. Hett's name appears also with just commendation as a preparer of objects in human and comparative anatomy. We consider his preparations as superior to those of other London anatomists.

No new information is furnished in regard to obtaining or mounting fossil infusoria. The same complicated directions are given for the preparation of infusorial earth, (that from Richmond is taken as an instance,) by digesting it in hydrochloric acid, then boiling it in nitric acid, then washing it, a process which requires several days. If Mr. Quekett had read Professor Bailey's published directions for obtaining the silicious shells from this or almost any infusorial earth, by simply placing the earth in a conical vessel, an ordinary wine-glass for example, adding a little water, stirring it briskly for a few seconds, when the shells will rise to the surface and adhere to the sides of the glass,—he might have spared his readers who consult him on this head, much trouble.

The localities out of England in which infusoria may be found, are given with a remarkable degree of vagueness. Thus we are informed that recent infusoria are found "in America, in seven localities." If the number had been stated at *seven thousand*, it would still have fallen much below the real number, for there is hardly a pond or stream in the country, which will not at some season yield beautiful and remarkable species.

So in the localities of fossil infusoria, we have in both editions "Rappenhanock-cliff, America," and "Richmond, North America." Considering that the infusorial deposit at Richmond is one of the most extensive and richest in beautiful forms of any in the world, and as such is generally known to all microscopists, we should have thought that in the lapse of time between the two editions, Mr. Quekett might have arrived a little nearer the precise locality of Richmond, than North America. We would

suggest that should Mr. Quekett's work reach a third edition, he may safely affirm Richmond to be in the United States of North America, leaving the particular State in which it is located, to be determined by future geographical researches.

The chief advances made in microscopical apparatus, since the former edition of the work before us, seem to be in an immense number of condensers and illuminating prisms. No less than eight new forms of this kind of apparatus are described and figured, and some more complicated than the microscope itself. Many of these pieces of mechanism are for obtaining oblique light, for ever since Mr. Spencer demonstrated how much better certain lined-objects could be defined by very oblique light, opticians have not been slow to act upon the information; and the stages of English miscroscopes are usually so thick that it is impossible to obtain any great amount of obliquity from the mirror.

The most faulty chapter in the whole book is the one on test-objects. This is common ground on which all microscopists meet, and no better evidence can be offered of the improvements in microscopes of late years, than the gradual adoption of more difficult tests, for the same focus object-glasses. Only a few years ago, the Navicula Hippocampus was sent to this country from England as the test *par excellence*, and within the last six months we have seen an advertisement of a Dublin optician, whose $\frac{1}{12}$th "will shew that severe test, the Nav. Hippocampus, perfectly well," and yet many gentlemen who were present last August at the Scientific Convention in Albany, will remember to have seen that "severe test" thoroughly defined by one of Mr. Spencer's *half-inch* objectives.

Mr. Quekett has not only furnished no description of any new test, but as before stated, he has omitted the account of the Nav. Spencerii, which was a severer test than any he has described; not that we object to the omission of that description, or the plate, for both were grossly erroneous as to measurements and general structure. To be sure, in the appendix we are informed in a short paragraph, that two new tests, the Nav. Amicii and the Grammatophera subtilissima "from America," have been employed, both of which "Mr. Ross' object-glasses of $\frac{1}{12}$th of an inch focal length, and 152° angular aperture, exhibit satisfactorily." If so, why not have described and figured them for the benefit of those who have passed beyond the Podura, and N. angulata, and wish to know what they must look for in the new tests, both of which have now been before the microscopic world for more than two years. Such a plate might well have taken the place of Mr. De la Rue's "Scale of Amathusia Horsfieldii," which, in addition to its being altogether inappropriate to such a work, had been already elsewhere published: besides, after the "faithful delineation" of the N. Spencerii in the first edition, we are not inclined to attach

much value to any drawing Mr. De la Rue has the "kindness to furnish."

In conclusion, while we cordially recommend Mr. Quekett's work as by far the best to be obtained on practical microscopy, yet we must protest that it by no means furnishes a complete exposition of this branch of microscopical science. The second edition continues to be what the first emphatically was, *an account of the state of microscopy in London.* As such we believe it to be faithful and correct. H. V. A.

Art. XII.—*On the Resinous Nature of Coal.*

Read before the Boston Society of Natural History, 7th April, 1852, by J. E. Teschmacher.

The paper I last read before the Society, advanced the proposition that, the Stigmaria so abundantly and so universally found in the coal formations, was a resinous plant, identical with the genus Picea. I will now support this by evidence tending to show the existence of other Coniferous plants at this period, as well as the general resinous nature of coal of all descriptions. The following specimens are produced for this purpose.

1st. A slice of southern pine (Pinus Australis) in which, owing to its resinous nature, the glandular vessels of the coniferous tribe are very clearly visible.

2d. A slice of the same carbonized, in order to show the appearance of these glands when changed by this action.

3d. A specimen of anthracite, and one of Cumberland coal, in which these glandular vessels are extremely distinct. Such specimens are quite common in the Pictou and other coal.

4th. Impressions in the shale, from Carbondale, Pa., of the leaves of a species of Pinus.

5th. A specimen of the same shale, showing an impression of the base of a bunch of leaves and its sheath at the junction, with the stem.

On comparing the latter with the accompanying specimen of the Pinus australis of the present day, its close resemblance is very evident, fitting the impression almost as if moulded from it.

On the side of the recent specimen adjacent to the axis of the branch, is a protuberance formed by the vessels which penetrate the bark, and depressions on each side thereof; the impressions of these in the shale although faint, bear a close resemblance. In many of the leaves of the recent fir tribe, there are rows of glands extending from the base to the summit, and in some, very minute spines on each edge: it cannot be expected that these microscopic characters should be visible in impressions on so coarse a

material as the shale, but no doubt they will be found when similar impressions are discovered in the coal itself. Other impressions of leaves of Coniferæ are in my collection, some in the anthracite, but although I have little doubt of their being leaves, they are not so undeniable as to be exhibited as proofs.

I pass on to chemical evidence.

Lehman, in his Physiological Chemistry states that, *formic acid* is found in coal during the process of decay (eremacausis), and also that it is found in the berries of the Juniperus, and in the cones of several of the fir tribe. Redtenbacher finds formic acid in the leaves and twigs of the fir tribe during the fermentation (incipient eremacausis). A few years ago Pelletier and Walther examined the products of the distillation of resin tar, and found therein two substances which they named *retinnaphtha* and *retinnyle*, and then the well-known *naphthaline*. The progress of organic chemistry has since shown the former substances to be the *Toluole* and *Cumole* of the present day. In 1849, Mansfield, at the instigation of Dr. A. W. Hoffman, investigated the products of the distillation of coal-tar from gas works, chiefly, however, with the view of ascertaining the boiling points of the various educts.

He tabulates the neutral results of his distillation as follows:

1st. Benzole	$C^{12}H^{6}$			
2d. Toluole	$C^{14}H^{8}$	the retinnaphtha	}	of Pelletier and
3d. Cumole	$C^{18}H^{12}$	" retinnyle	}	Walther.
4th. Cymole	$C^{20}H^{14}$			
and then Naphthaline.				

I will now simply advert to the opinion of Göppert, in his prize essays. He supposes the origin of the coal to be from a fermentation, and consequent eremacausis of vegetable matter. Others suppose this vegetable matter to have been chiefly mosses, such as form the large accumulation of peat. My view is that coal is chiefly composed of resinous trees (conifers) and oleaginous trees (palms), these latter being in excess in the cannel coal.

I now wish to show that all coal has been formed from nearly the same original materials, and probably nearly under the same circumstances, from the anthracite to the most bituminous. This I propose to do by exhibiting these specimens selected from many hundreds in my possession, of anthracite coal from Pennsylvania, of cannel and bituminous coal from the Cumberland basin, and from Hillsboro'; specimens from Pictou and other localities might have been added. The comparison of these, the exact similarity in their structure, marks of organisms, and peculiar fracture, can leave but little doubt on the subject; they exhibit, however, but a small portion of the resemblances manifest on a minute and extended examination.

From what cause, then, can arise the difference in various coals? At present only three characters of diversity are apparent: specific gravity, quantity of carbon, and quantity of hydrogen. To show this the following descending scale may be used.

	Hydrogen.	Carbon.	Specific gravity.
Asphaltum,	9 per cent.	78·10	1·063
Hillsboro' Coal,	———	———	1·09 to 1·12
Cannel, "	5·66 to 6·00	81·00	1·28
Bituminous " various,	4·80 to 5·60	81 to 86	1·29 to 1·32
Anthracite, "	2·40 to 4·20	89 to 92	1·34 to 1·47
Graphite,	none	99	2 to 2·27

The difference in specific gravity and carbon seems to depend on the diminution of the hydrogen. How this has been separated, whether by a process of time, of pressure, of heat, or as is most probable, by a process of which we are entirely ignorant, must be a subject for future investigation.

It must be obvious that the foregoing is but a very faint outline of some of the results of my yet imperfect examination of this subject, imperfect, mainly because the means of a more perfect one are yet out of reach. The chemical analyses of coal have hitherto been undertaken chiefly with commercial views, and altogether to obtain ultimate principles. But the daily operations of the gas works exhibit products, showing that much has yet to be done in these analyses, to satisfy the increased progress in the science of organic chemistry. My own experience has also led me to the conclusion that much more remains to be accomplished in the study of the internal structure and contents of coal*, and that the vast and varied coal formations of this immense continent, are chiefly to be relied on as the fields of this study.

The consequences to geology, should the truth of my views be finally sustained, are obviously of importance, with respect to the present opinion on central heat, on the atmospheric state of these early periods, and on other points, on which this is not the proper time to enlarge.

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* On the application of heat many anthracites separate into laminæ as thin as paper. These are alternate layers of hardened resinous hydrocarbon, and of vegetable matter, often retaining in its state of ashes its original forms; this last is the first burned out, leaving the laminæ of the former exposed. A chemical comparison of the ashes of the vegetable layers, selecting only that part where form permits no doubt, with the ashes of recent plants, particularly of Coniferæ and Equisita, would be very interesting,

ART. XIII.—*Description of a Slide on Mount Lafayette, at Franconia, New Hampshire;* by President EDWARD HITCHCOCK.

IN August, 1851, in company with S. C. Carter, Esq., of Amherst, Mass., and Mr. Daniel Bliss, of the senior class in Amherst College, I visited the White Mountains of New Hampshire. We first went to Franconia Notch, and from thence we ascended La Fayette Mountain, which, without attempting great accuracy, I made, by the aneroid and syphon barometers, 5,164 feet above the ocean. It can be ascended only by a very wretched foot-path, among vast quantities of detritus, with most of the surface covered with low evergreens, whose thick-set branches make it almost impossible to force our way through them, if not previously cut out. The ascent is about three miles, and the view from the summit as grand, for aught I could see, as that from Mount Washington, which is about 2,000 feet higher.

In our descent from the mountain, I noticed a hundred rods to the right of the path, and perhaps a thousand feet below the summit, the commencement of a slide; and the large amount of rock laid bare at its upper end, incited a desire to visit the spot. From thence the slide took a southerly direction, passing down a deep ravine, which, within a mile, seemed to approach near to the path by which we ascended, and still farther down, we thought it could not be very distant from the Notch House Hotel, from whence we started. With great difficulty we clambered over the angular blocks, and through the tangled bushes, to the head of the slide. Having taken courses a little diverse, we lost sight of one another; and it was with great difficulty that we at length formed a reunion again, at the head of the slide. There we saw a mass of naked gneiss rock, many rods wide, mostly denuded of soil, and much of it also of several layers of the rock, which had slid downwards, and were strewn along the sides of the ravine, for at least two miles. This naked surface, at its upper part, had a slope of about 38°. Lower down, however, it was much less, for the most part, and at its termination the descent was slight. A brook commenced quite as high I think as the slide, and this increased rapidly as we descended, until it became a streamlet of considerable size within five or six miles.

But I will first describe some of the unexpected perils we met in our descent, as a caution to those who traverse mountainous regions covered with unbroken forests. At first the rock in the bed of the slide was so steep and smooth that it was with difficulty we worked our way downward. And then, if we tried to walk along the bank, so irregular and loose was the detritus piled up in ridges, and so tangled the brush a little beyond, that to get along was still more hazardous and difficult. We

went safely forward, however, till we reached that part of the ravine nearest the footpath, through which we had ascended. But we found ourselves several hundred feet below it, and the spruces so thick and matted together, that to make our way through them seemed a formidable undertaking, and so we concluded to follow down the stream till we should come to the mouth of a brook, which we knew passed the tavern and emptied into this ravine. Onward we went, stepping from stone to stone in the bottom of the creek, until we began to suspect something wrong; and my pocket-compass showed me that the ravine was turning gradually to the right, so as to carry us towards the mountain-range, and away from the hotel. The stream was from one to two rods wide, and the banks covered with trees from eighty to one hundred feet high, so that we could see only a short distance on either hand. We passed the mouth of the brook, which we meant should be our guide, without observing it. It was impossible over such a road to judge of the distance we had travelled, but it seemed very long; yet we did not dare to leave the stream, lest we should lose our way in the vast forest. A commencing rain towards night made the prospect the more gloomy, as we had no means of making a fire.

On we still went, and the stream finally was so much enlarged, that we could no longer step from stone to stone, along its bed, so that we were obliged to get on as we could through the brushwood, and among the rocks on the shore. At length, turning my eye towards the top of a steep hill, that formed the bank, I thought I saw through the forest, a single stump bearing the marks of an axe. One of our number ascended the hill and announced a cleared field and a farm-house in sight. Cheered by the discovery we pushed forward, and ere long were resting in a farmer's kitchen, before a good fire. We ascertained, on inquiry, that we had followed the stream six miles from its source, and had advanced three miles beyond the hotel. The farmer's wagon conveyed us thither, in the early part of the evening, and though excessively fatigued, sleep restored us, so that on the morrow we went on our way.

But though we met with such unexpected difficulties in this case, as geologists we were amply repaid for all our anxieties and fatigue. It was just such an example as I had long wished to find. An enormous mass of detritus, probably from ten to twenty feet thick, and in some places two or three rods wide, composed of irregular fragments of all sizes, from twenty feet diameter down to sand, had deen driven forward, over a rocky surface two miles long. What now was the effect upon the rocky floor? Did it score and striate that floor as was done by the drift agency, as some suppose would be done by the crowding forward of detritus by the power of water? I found it

was not so. The rock in place was smoothed, but not striated; except in a few places, perhaps, in the slightest manner. The fundamental rock passed over, is gneiss, but it is traversed occasionally by veins of granite, and towards the upper part by dykes of trap several rods wide. They are such rocks, indeed, as in various places retain distinct markings of the drift action. I conclude, therefore, that the drift agency must have been somewhat different from that which produced this slide.

The beds of detritus, produced along this slide, are so closely like those of glacier origin, that we may call them *moraines.* They are larger and more distinct than I have seen on any other slide. All along the borders of the ravine, are ridges of blocks, gravel, and sand, sometimes twenty feet high, lying in as much confusion as is possible, and making it difficult, and even dangerous, to go into, or out of, the ravine over the loose and crumbling ridges. At the lower end of the slide is a large terminal moraine, by which the river has been forced, to seek a new channel. This terminal moraine is in fact double, that is, an old moraine lies in advance of that produced by the slide of 1850. The blocks of the two being easily distinguished by the appearance of recent of more ancient erosion. In short, the appearances along this gulr are almost precisely what they would be, if a glacier in one of the valleys of the Alps should melt away. And when examining it, I had no doubt that the slide was produced by the advance of a mass of ice. Yet I noticed that in some places, the lateral moraine was driven in among the trees, without affecting them, and subsequently I learned, that the slide took place in June, 1850, in consequence of a powerful shower of rain.

In some places near the bed of the slide, I noticed the stumps of trees, perhaps six inches diameter, that had been broken off by the descending mass.

We were so struck with the perfection of these moraines, that we ventured to call this hitherto nameless stream, *Moraine Brook;* and we entered it as such on the register at the hotel. If any wish to get an idea of the moraines of the Alps without the glaciers, I would advise them to visit this spot.

A little below the terminal moraine, we found springs issuing, strongly impregnated with iron, which, with a little fitting up, might be serviceable to the numerous visitors of the Franconia hotel, where so many objects of interest are clustered together.

Some of the trap that has been denuded by this slide, is columnar. I saw none such in place, but one or two very distinct examples of hexagonal joints lay along the bed of the stream.

I learnt at the hotel that Moraine brook lies at the best possible route for a horse-path, to the summit of La Fayette. No such path now exists; but I understood it to be the intentions of the

proprietor of the hotel to construct one. If he will do this, so as to lead the traveller along this slide, and past the mineral spring, and thence to the summit, it will be a most interesting route. At present, ladies, unless very robust and courageous, will hardly venture to scale this mountain. But with such a path they would find it much more accessible than Mount Washington, because the distance is little more than half as great; and as the view from the summit of La Fayette is equal in my opinion to that from Washington, I think the former would be the chief centre of attraction, to visitors to the White Mountains. Since these mountains afford scenery of unusual interest, and as an excursion thither is eminently conducive to health, I am anxious to see inducements multiplied for making this summer excursion more frequent.

Art. XIV.—*On Coral Reefs and Islands;* by James D. Dana. Part Eighth.—With a Map.

Geological Conclusions from the Sturcture and Composition of Coral Reefs and Islands.

The geological bearing of the facts that have been detailed, has probably been already perceived by our readers. A brief recapitulation, however, may afford a convenient review of the subject. The following are the points of more special interest.

I. The *coral reef-rock* has been described as solid limestone of coral origin. In some parts it is a coral conglomerate, or breccia, made up of fragments firmly cemented. Over much larger areas it is a fine white limestone, as compact as any secondary marble, and as homogeneous in texture. It is often free from any traces of organic life, or proofs of an organic origin. Only now and then an imbedded shell or some other relic evinces that animals of any kind were living in the seas. This white limestone breaks with a conchoidal fracture, a splintery surface, and rings under the hammer. These facts are of great importance in deciding upon the origin of the older limestone strata. Other portions of the rock, of less extent, are made of standing corals with the intervals filled in by reef-debris, and the whole cemented solid. The latter variety here mentioned prevails in the inner patches growing in quiet waters. The former kind is common about outer reefs, since large areas in the coral plantation are mere sand. It is still more abundant, forming the bottom among the inner patches, or in the lagoons, where the finer detritus is washed by the sea. A glance at the chart of the Feejees or at the Kingsmills, (a copy of which, from Capt. Wilkes's Narrative is inserted in this vol-

ume,*) will show how large a portion of the reef increases from these fine accumulations. The exterior of a coral island, for a few hundred yards, excepting some islets within, is the only part which is the proper growth of the living reef. Within the exterior reef the coral structure may consist almost wholly of the compact homogeneous white limestone we have described. The elevated island of Metia was for a long time after elevation exposed to the ravages of the sea, before the present shore-reefs accumulated to give it protection. Proofs of degradation along the coast have been referred to. There is much reason, therefore, for believing that the Metia now existing, exposes on its eastern and southern sides at least (where particularly examined by us) the interior of the original structure; and this view is supported by the compact character of the rock.

These reef-rocks receive also large contributions of sand or fragments from shells, which unite with the coral debris.

Besides the coral rocks formed beneath the waters surface, the beach or drift sands and gravel form stratified deposits of considerable extent, either bordering the shores within the range of the tides, or raised some distance above them. These drift-sand formations may cover the forming island and contribute largely to its progress; and sometimes they accumulate into drift hills forming when consolidated, hills of rock occasionally 60 or 80 feet in height. The rock is often loose and friable, but sometimes quite solid. The layers of the beach rock have a nearly constant dip of a few degrees, not exceeding eight, towards the water. The rock of the drift-hills or accumulations is more finely laminated, less firmly cemented, and dips whichever way the accumulating sandhill sloped, the layers being the successive sheets of sand which were drifted over it.

II. Coral reefs, though they may stretch along a coast for scores of miles, are seldom a single mile in width at the surface: and if elevated above the sea, they would stand as broad ramparts separated by passages mostly 20 to 200 feet deep, and often of great width. The substratum, however, is continuous coral-rock; and if these more elevated parts were removed by any process, after an elevation, they would leave an area of coral limestone often as extensive as the whole reef-grounds. This is at once seen from the figures of the Kingsmill chart and others on a preceding page. In an island like Deans's, one of the Paumotus, these reef-grounds are 1000 square miles in extent. It is true that the reefs at the surface gradually widen if the land is undergoing no subsidence. But when situated on a sloping bank, as usual, this

* This chart presents to the eye a map of one of the most remarkable reef-grounds in the world; and the whole theory of coral islands is illustrated in its different parts, in the fullest and clearest manner.

widening gradually renders the bank steeper, and the rate of increase in width is rapidly diminished. And if the bank were not sloping, there is still reason to believe that the patches would not attain a great width at the surface of the sea, owing to the currents sweeping over them, occasioned partly by the position of a growing reef; and that therefore there would be unoccupied intervals or channels, as above alluded to, between the several reefs of a reef-ground.

The bearing of these facts upon the character and origin of ancient limestones, and the formation of channels, or valleys in such rocks, is apparent without particular explanation.

III. The occurrence of coral sand forming the exposed beaches, while the finer coral mud exists on the shores of the smaller lagoons, or at the bottom of the larger, affords an interesting illustration of the result produced by a triturating sea, as compared with that from more gently agitated waters. The rude seashore waves give rise to sand or pebbles; while the gentle undulations or ripplings of inland waters produce mud by their finer trituration. In the latter case the finely comminuted matter is retained beneath the quiet waters, in the former the rude action washes it away.

IV. The almost total absence of fossils from many parts of the coral reef-rock, and generally from the shore sandrocks, is one of the most striking facts here exemplified. These rocks are formed in the midst of life, and out of the enduring remains of animals; yet fossils, (as shown at Metia and other elevated reefs,) are often rare.

This absence of organic remains characterizes almost invariably the *drift* sandrock. On Oahu, where this rock forms hills thirty or forty feet in height above the reef-rock, not a fossil nor a fragment of one was distinguished by us, neither of shells nor corals. This fact had been previously remarked by some of the intelligent residents, and it was a matter of dispute whether one or two shells had not been found. These formations are but a few rods from waters prolific with the productions of the sea, and were made from them.

An explanation of this peculiarity, is obvious on the principle already discussed—the action of a triturating sea. Everything washed towards the shores, is ground down by this action and reduced to sand; and a large part of the sand is worn out and carried off by the sea; or, being thrown up by the reef, is blown inward by the winds.

It is a natural inference from these facts, that the non-fossiliferous sandstones of our continents are no good evidence of the absence or sparing diffusion of animal life in the seas about whose shores they may have been formed. If this destruction of fossils is so complete when the sands are of limestone, much more

rapid and thorough should it be when they are siliceous. As the sea by its action bears off the finer material, and leaves only what is in the condition of sand or a coarser material, the lime of fossils might be almost wholly removed from among siliceous sands, and hardly a trace remain which the chemist could detect.

V. The formation of *chalk* from coral is known to be exemplified at only one spot among the reefs of the Pacific. The coral mud described appears to be a fit material for its production; and when dried it takes much the appearance of chalk. This fact was pointed out by Mr. Darwin, and was suggested to the writer by the mud in the lagoon of Honden Island. Still it does not explain the main point; for under all ordinary circumstances, this mud solidifies into compact limestone, instead of chalk. This appears, moreover, to be the result which should be expected. What condition then is necessary to vary the result, and set aside the ordinary process?

The bed of chalk referred to was not found on any of the coral islands, but in the elevated reef of Oahu, of which reef it formed a constituent part. It is twenty or thirty feet in extent, and eight or ten feet deep. The rock could not be distinguished from much of the chalk of England: it is equally fine and even in its texture, as earthy in its fracture, and so soft as to be used on the blackboard in the native schools. Some imbedded shells look precisely like chalk fossils. It consists, according to an analysis by Prof. B. Silliman, Jr., of

Carbonate of lime, . . .	92·800
Carbonate of magnesia, . .	2·385
Alumina, ...	0·250
Oxyd of iron, ...	0·543
Silica, ...	0·750
Phosphoric acid and fluorine, . .	2·113
Water and loss, . . .	1·148

The locality is situated on the shores just above high tide level, near the foot of Diamond Hill. This hill is an extinct tufa cone, near seven hundred feet in height, which rises from the water's edge, and in its origin must have been partly submarine. It is one of the lateral cones of eastern Oahu, and was thrown up at the time of an eruption through a fissure, the lavas of which appear at the base. There was some coral on the shores when the eruption took place, as is evident from imbedded fragments in the tufa; but the reef containing the chalk appeared to have been subsequent in formation. There is no certain proof yet ascertained of any connection between the fires of the mountain and the formation of the chalk.

The facts leave the subject of the origin of chalk still in uncertainty. Its fine earthy texture is evidence that the deposit was not subaerial seashore accumulation, as only sandstones and conglomerates, with rare instances of more compact rocks, are thus formed. Sandrock making is the peculiar prerogative, the world over, of shores exposed to waves, either marine or fresh water. We should infer, therefore, that the accumulations were produced either in confined areas, into which the fine material from a beach may have been washed, or on the shores of shallow, quiet seas: in other words, under the same conditions nearly as are required to produce the calcareous mud of the coral island. But, although the agency of fire in the result cannot be proved, it is by no means improbable, from the position of the bed of chalk, that there may have been a hot spring at the spot occupied by it. That there were some peculiar circumstances distinguishing this from other parts of the reefs, is evident; and this appears to be the only probable supposition. If this be admitted, the existence of an elevated temperature might be suggested for certain areas during the deposition of the chalk strata. It is well known that heated waters dissolve lime much less readily than cold; and this might be a reason for its inferior hardness and earthy texture. The character of the cretaceous deposits presents many interesting points bearing upon this subject; but a discussion of them would be out of place here, as our object is simply to state such inferences as the facts observed among existing reefs may have suggested.

This coral chalk has been examined microscopically by Professor Bailey, for infusoria and polythalamia, without detecting anything of this kind. It appeared to contain nothing organic.

VI. The analyses have shown that ordinary corals consist mainly of carbonate of lime. There is a small proportion of fluorids and phosphates, with some silica, alumina, and oxyd of iron. These fluorids and phosphates, existing in the coral, must exist also in the limestone rock made from coral. It is probable from some trials made by Prof. Silliman, Jr., that these constituents may be found also in many shells.

From the several analyses of corals by Mr. Silliman, we infer that the fluorids and phosphates amount, on an average, to about ¼th per cent., or 0·25 parts in a hundred of coral: and the amount in the same manner of the phosphates, is 0·05 per cent. A cubic foot of coral, as deduced from the average specific gravity, weighs one hundred and fifty-seven pounds, and consequently, in each cubic foot, there must be full six and one-fourth ounces of fluorids, and one and one-fourth ounces of phosphates: and in each cubic rod seventeen hundred pounds of fluorids, and three hundred and forty pounds of phosphates. These fluorids are fluorids of calcium and magnesium, and the phosphates, phosphates

of lime and magnesia. To obtain the amount of these ingredients in a reef a mile long, half a mile wide and a hundred feet deep, the estimate for a cubic rod should be multiplied by 320,000; which will give for the fluorids more than five hundred millions of pounds.

Late geological researches have placed it beyond doubt that the various limestones consist mainly, like coral limestone, of animal remains, among which, in many instances, corals have a conspicuous place. These limestones often contain crystallizations of fluorid of calcium (fluor spar); and in other beds which have been acted upon by heat, and thus rendered crystalline, there are, besides this mineral, crystallizations of apatite, (phosphate of lime,) and chondrodite (consisting of fluorine, magnesia and silica). Moreover, these are among the most common minerals of such limestones. The above facts supply us with a full explanation of their origin. The fluorine, phosphoric acid, magnesia, and silica present, are adequate for all results, without looking to other sources for the elements of these disseminated minerals. Instead, therefore, of being extraneous minerals introduced into the limestone rock, they are (or may be in some instances) an essential part of its constitution. And they have been separated from the general mass by a segregation of like atoms, under well-known principles, while the rock was subjected to an elevated temperature. The fluorid of calcium appears to crystallize without much heat; but apatite and chondrodite are found mainly in *granular* limestones, which show, by their crystalline texture, that they have been subjected either to a very high temperature, or to one long continued of more moderate degree.

Lord Byron, of the Blonde, states that specimens of *phosphate of lime* (apatite,) were actually collected on Mauki, of the Hervey Group, one of the elevated coral islands.

VII. The cementation of coral sand along shores and beneath the sea is illustrated among all reefs, and is the process by which reef-rocks are formed. The sea-water receives some carbonate of lime into solution, and again deposits it among the deposited sand and fragments which lie compacted together. The same process takes place among the beach sands and the drift heaps. The eminences of drift sandrock at the Sandwich islands were covered in part by a smooth, solid crust, two or three lines thick, and made of layers like stalagmite, which was formed by the solution of lime from the surface by the rains, and its deposition again on evaporation.

The waters of the sea have been found to contain a small proportion of free carbonic acid, which is sufficient to enable it to dissolve the carbonate of lime of the corals.

Analyses of the coral limestone of the elevated coral island Matea, by Prof. B. Silliman, Jr., have determined the singular fact that although the corals themselves contain very little carbonate of magnesia, this salt is largely present in some specimens of the rock. The rock is hard (H. = 4·25), and splintery in fracture, with the specific gravity 2·690.

Carbonate of lime, . . .	61·93
Carbonate of magnesia, . .	38·07*

Another specimen from the same island, having the specific gravity 2·646, afforded 5·29 per cent. of carbonate of magnesia. The first was a compact, homogeneous specimen, and the other was partly fragmentary. Recent examinations of coral sand, and coral mud from the islands, give no different composition, as regards the magnesia, from that for corals. The coral sand from the straits of Balabac afforded carbonate of lime, 98·26, carbonate of magnesia, 1·38, alumina, 0·24, phosphoric acid and silica, a trace.

We cannot account for this supply of magnesia except by referring to the magnesian salts of the ocean. It is an instance of dolomization, during the consolidation of the rock beneath seawater, and throws light on this much vexed question.

This subject is illustrated, and the view we sustain confirmed, by an article on the formation of dolomite from carbonate of lime, published in the Naturwissenschaftliche Abhandlungen edited by W. Haidinger, (4to. Vienna, 1847.) According to von Morlot, in this paper, Haidinger has recently shown both by the frequent association of gypsum with dolomite, and by chemical experiment, that carbonate of lime and sulphate of magnesia, when together, undergo a double decomposition, the magnesia taking the place of part of the lime, and the excluded lime combining with the sulphuric acid set free. The result is *magnesian carbonate of lime*, (dolomite,) and *hydrous sulphate of lime*, (gypsum,) the latter being separated, and either continuing in solution or solidifying, according to the amount formed or the proportion in the water. Von Morlot gives figures of specimens from different localities in which gypsum and dolomite are intimately associated; and among them are some of fossil corals.

According to Haidinger, however, some heat is required for this result. Yet in the case of the coral rock and the *compact* magnesian limestones of our Western States, there is no evidence of the action of such heat; the subject therefore requires farther investigation.

The circumstance of a chemical change going on between the carbonate of lime and magnesian salt, (for such a change, under

* The *magnesia* in this analysis was directly determined, the lime being inferred from the loss.

some circumstances, must have taken place,) is especially favorable for consolidation. When the coral is a fine mud, and the grains are therefore extremely fine, the dolomisation might extend to the grains themselves, as well as the infiltrating material acting as a cement. But when the grains of coral are large, or there are pebbles, the infiltrated material that might be magnesian would constitute but a small part of the whole bed. Hence it is obvious that such formations in cold waters should not always in the mass have the proportions of a true dolomite, (54·2 of carbonate of lime, to 45·8 of carbonate of magnesia;) they would probably attain such proportions under an ocean during that action of heat required alike for crystallization and chemical combination.*

VIII. It is an inquiry of some interest, whether, in an archipelago like the Paumotus, coral debris is not carried from the coral islands, and distributed over the bottom of the ocean; and whether limestones thus originating, are not in process of formation. I venture no positive assertion on this subject, yet would express strong doubts. The fact that soundings off some islands, as we recede from the reef-growing depths, lose more and more in the proportion of coral sand, till we finally reach a bottom of earth, like the material of the island, bears against any such hypothesis. This was found to be the case off Upolu, where the reefs are extensive.

The action of the waves tends to throw back the material washed into the sea by fresh water streams and other currents, and in this manner extensive shore or shallow-water accumulations have been formed in all ages of the world. The formation from land debris of deep sea deposits, outside of soundings, is an hypothesis of geologists, yet to be proved. Such results may perhaps take place off the mouths of large rivers like the Amazon,

* Prof. Horsford, in a paper on the consolidation of coral reef-rock, read before the last meeting of the American Association at Albany, (August, 1851), attributes this consolidation to the presence of organic matter which undergoes decomposition, as follows:—the sulphur present produces sulphuretted hydrogen; this changes to sulphuric acid, whence results sulphate of lime and a soluble carbonate of lime; then ammonia (resulting from the nitrogen) carries off the sulphuric acid as sulphate of ammonia and leaves the lime as a soluble hydrate, which remains united with the carbonate of lime, forming a compound like that indicated as existing in mortar by Fuchs; the final removal of the water by evaporation leaves the rock in a crystallized state.

In the first place, his paper only alludes to the rock formed above low-tide level, which I have called the coral sand-rock. Again, the amount of organic matter in corals, as found by analyses, does not exceed 5 per cent.; and the sulphur present in this organic matter is not over *one-tenth of one* per cent. It hence appears that the amount of sulphur is altogether inadequate for such changes.

But as the sands of the beach (which have a peculiarly white and clean appearance) are washed by the breakers, and the animal matter they contain is either undecomposed within the several grains, or is borne off by the waters, even the animal matter present cannot contribute to the consolidation. The waters of the tides along a sand beach on the open ocean have certainly not been proved to carry in dissolved animal matter for dissemination among the sands.

the force of whose currents carries their transported material far to sea; but not, it would seem, in any case where the streams are small, or where the river current can not be traced out to sea much beyond soundings.

IX. It remains still to speak of the proofs of elevation or subsidence presented by coral islands throughout the Pacific, and of the former extent of Pacific lands compared with the present. But these topics relating to the dynamics of the ocean, form a separate chapter, following our geological descriptions of the several groups of islands in the Pacific.

We might dwell also on the formation of caverns by the rains becoming subterranean waters; on the illustration of the action of marine currents afforded by this subject; on the agency of polyps in rock-making. But the deductions are too obvious to require farther remark.

Art. XV.—*Remarks on the proposed Geographical Survey of New York.*

A memorial was recently addressed to the Governor of New York, by a committee of the American Association for the Advancement of Science, appointed for that purpose at its Albany meeting, urging the speedy commencement of a Trigonometrical and Topographical Survey of this State. This memorial was sent to the Senate with a favorable message by the Governor, and referred to the Committee on Literature. It may, therefore, be interesting and useful to present somewhat fully the history of the kind of survey proposed. In doing this, the writer would profess himself a decided advocate of the measure, but one who has no personal purposes to serve.

At the outset, it may be well to know what has been done by other civilized nations, for this will indicate how highly minute topographical surveys are esteemed by those having most experience of their uses. It should be remembered that topography is a new art. A century since, topographical geography scarcely existed at all. Slowly emerging from its nebulous age—shedding its puerilities and unveracities by experience of better things, as it has now become systematic, eminently accurate in its field work, and spirited and trustworthy in its representations. Its capacities are equal to representing all cases of surface in a manner unmistakeable by a moderately practised eye. It pictures a country in all its detailed accidents of ground with so much unity of effect and due relation of parts, that the whole rests on the mind as a picture, all the parts of which are in true similitude and relation.

The last half century has seen the governments of Europe, almost with one accord, embarking their resources of mind and wealth in topographical surveys of their respective territories.

In these labors, France deserves the place of pioneer. Prolific in great geometers, and keenly sensitive to the magnificent, both in country and in fame, she has applied, with peculiar liberality, her wealth and the talents of men like Cassini, Delambre, La Place, Mechain, Biot, Arago, and Puissant, to a Survey and Topographical map of France, noble in conception, scrupulously correct in execution, and embodying all important accidents of ground. The scale of the final map is $\frac{1}{8\,8\,0,0\,0\,0}$, and it will contain 250 large engraved sheets, of which 149 are now published. This map really gives a better idea of the surface of France than could be derived from any travels. The map of Corsica, on a scale of $\frac{1}{1\,0\,0,0\,0\,0}$ makes an additional French contribution to topography. French geographical enterprise has also been exhibited by numerous costly explorations and voyages, by the valuable maps and battle fields of the "*Depot de la guerre*," and by the hydrographic labors of the "*Depot de la Marine.*" From each of these, hundreds of sheets have been issued, covering Turkey, Russia, Algeria, and furnishing charts of ports in all lands. These are mainly of a high style, though deficient in accuracy from the imperfection of surveys.

Great Britain has, with deep sagacity, applied lavish means to forming a correct geography of her wide-spread dominions. The ordnance surveys of England, Ireland, and Scotland, now severally in progress, are of the most elaborate nature and afford results unsurpassed in fidelity and minuteness. The Trigonometrical survey of East India occupies a high rank among geodetic operations, and has been steadily prosecuted, fearless of expense, forty sheets of topography being now published, twelve more in hand, and the triangulation well advanced. By a comparison of the Government Survey and map of Canada with the best New-York map extant, we shall see cause for wonder, if not for shame. The very numerous and expensively prepared charts from the English Admiralty Office, show what geographical zeal, when stimulated by commercial enterprise and forecast, can accomplish. These noble geographical labors of Great Britain, both internal and external, are intimately allied with that profound commercial policy which has made her so preëminent. A keen scent for mercantile opportunity has guided her explorers to the earth's end, and a judicious perception of the value of local knowledge to every pithy undertaking, has led to systematic liberality in shaping and publishing the results of exploration.

Germany, the labyrinth of geography, has throughout her petty principalities, exhibited a proficiency and refinement in the field and record work of Geodetic Surveys, a steady determination in prosecuting them to the end, and a copiousness of scientific resource every way honorable to herself and instructive to other nations. In Holland, Bavaria, Baden, Wirtemburg, Hesse Darmstadt, Hanover and Brunswick, Topographical Surveys, based on systematic triangulations, are either made or in progress. Some of the magnates of modern science have liberally bestowed their energies and abilities on these great works, giving them a monumental and ever-enduring character.

Switzerland has thought it due to herself and the world, that her stupendous Alps and peaceful lakes should be mirrored in a topographical picture. That land of scenic grandeur and patriotic struggle, by concurrent action of its Cantons, has, under General Dufour's guidance, been busy gathering the drapery of her magnificence into a map miniature, of thorough accuracy and finish. We cannot wonder at any great achievement of a nation, so rich in intellect as of her superfluity to give us an Agassiz and a Guyot.

The sunny, vine-clad hills and fields of Italy have sent forth to the world a topographical likeness of their varied surface, such as to stimulate the imagination to a realization of her myriad homes of history and song. Carlini gave to the survey of Upper Italy, a high excellence, and the map of Piedmont may, perhaps, challenge the world in its finish of style.

A Prussian survey of the highest character is now in active progress, its publications being already much advanced. Its geodesy, under the illustrious Bessel, became a very model for such undertakings.

Austria, displaying a munificence which has long characterized her deportment towards scientific enterprises, has lavished on the geographical illustration of her own territory, whatever was necessary to the most complete results. The Institute of Vienna is a systematic contributor on a large scale to the world's geographical resources. During the last year, it has, besides other important works, published a map of Italy, in 27 large sheets, on a scale of $\frac{1}{518,400}$.

A government survey of Denmark has been progressing under the direction of the late lamented Schumacher, whose name is a voucher for everything excellent in scientific operations.

The "Topographical Survey of Sweden," to consist of 260 sheets, is rapidly advancing, being zealously prosecuted in spite of climate rigors. The liberal scale of this work, when we consider the restricted resources of the government conducting it, is alike honorable to the national intelligence and patriotism. The Swedish Admiralty charts bear additional testimony to that zeal

for science which belongs to the country of Linnæus and Berzelius.

In Russia, the government trigonometrical survey, under the eminently able guidance of the world-known Struve, assumes a character of gigantic magnitude, proportionate to the territorial expansion of that over-shadowing empire. Embracing twenty-one large provinces between the Baltic and Black Seas, only about one-fourth of European Russia is yet surveyed. A meridional arc of over 20° between Ismail, near the Black Sea, and Torneo on the Gulf of Bothnia, with an extension of 4½° in Sweden, links hyperborean and sunny climes by a triangulation chain the most stupendous on the earth. There is something almost appalling in an undertaking so nearly impossible to any but the great Autocrat.

Turning from this rapid view of foreign surveys to our own country, an oppressive sense of the littleness of our geodetic and topographical achievement fills the mind. The amplitude of our domain, its highly varied and beautiful features, the grand sweeps of our rivers, our fair lakes, strewn in tasteful profusion, are well nigh all unrecorded in that pictorial language of topography common to civilized nations. Engrossed in the great labors, incident to founding a nation, our people have scarcely had time to canvass the demands of science, art and international comity, or even of liberal home administration. That leisure is now slowly dawning on us which will permit us to enter on the duties and privileges of national maturity. The first great geographical fruit of this our maturity is the U. S. Coast Survey. Our Atlantic Gulf and Pacific coasts are divided into eleven distinct sections, within which independent operations are going on, and furnishing sound bases for topography and hydrography, Limited as this is to a narrow belt along the shore line, the interior of our country cannot look to this organization for a topographical survey, but the states, as such, must either survey and map their own territories, or remain in the same category as Turkey and Egypt, unsurveyed except by invaders.

In the work of interior surveys, Massachusetts, with her wonted enterprise and liberality, has been the first state to act. The result of her geographical survey has been a map, which though below the European standard of topographical accuracy and minuteness, enjoys a signal preëminence over the crude scrawls called maps of her sister States. The triangulation, conducted by Mr. Simeon Borden, is excellent, and will endure with the granite hills bearing its monuments. Thus, by the judicious expenditure of about $71,000, the Bay State has conferred on her citizens and neighbors a great benefit, and on herself a new title to renown. The convenience of this map has been and will be felt in a thousand nameless ways; in her intercommunication,

in developing her manufacturing and industrial capacities, and as a means of instructing its users in the physiognomy and special features of Massachusetts.

Here we must end our enumeration of good works performed, and it is not without the feeling that New-York will soon vindicate her claim to civilization, by enrolling herself among those States whose portraits have been taken. E. B. H.

ART. XVI.—*On the Electrical Properties of Flame;* by H. BUFF, *Professor of Natural Philosophy in the University of Giessen.**

PROFESSOR BUFF commences his memoir with a review of the divergent notions at present existing as to the electricity of flame; Becquerel finds electric opposition in all directions in flame, which depends upon the difference of the temperature of the metals immersed in it; Pouillet recognizes a motion of electricity only from the interior to the exterior, and hence also from the base to the summit of the flame; according to Hankel†, however the motion of the electric fluid, at least in flames obtained by the ignition of spirit, is exactly opposite, and independent of the temperature of the immersed conductor. To solve these contradictions was the object of the present investigation.

Two small strips of platinum were introduced into a glass tube closed at one end; they were separated by an interval of 1·5 line of air. The air within the tube could *not* be heated to a degree sufficient to permit the electricity of two of Daniell's cells to pass through it. When the glass became soft by heating, and both pieces of platinum were permitted to touch it, a strong deflection of the needle of a galvanometer was the consequence.

A porcelain tube two feet long and six lines wide was encompassed with glowing coals, and air was drawn slowly through it; this air could not be heated so as to allow the passage of the electricity from the source abovementioned, although the two platinum wires sunk in the air were less than a line apart, and were glowing red.

A metal web was placed over the flame of a spirit-lamp; the flame did not pass through; over the web the platinum strips were held a line apart—there was no passage of electricity.

The galvanometer used in these experiments was extremely sensitive. When two persons who were connected simply by the wooden floor, touched the ends of the wire which formed the helix of the instrument with different metals, a deflection of sev-

* Annalen der Chemie und Pharmacie, lxxx, 1.—Cited here from the Phil. Mag. [4], iii, 145.

† Ibid. [4], ii, p. 542.

eral degrees was obtained. The two cells before mentioned, when connected by the floor, caused a deflection of 25°. The wooden floor was thus proved to be an incomparably better conductor than air heated to 400° C.

When the strips of platinum were exposed to the direct action of the flame of a spirit-lamp, the first notice of the passage of electricity was obtained, when they were placed at about three inches above its extreme point, and began to show signs of redness. The deflection increased as the strips were lowered into the flame, and attained its maximum at a small distance beneath the point of the cone into which the flame shaped itself. When the flame was strongest, there was a permanent deflection of 75°.

In these experiments, care was taken to preserve the strips of platinum as nearly as possible at the same temperature. The two cells were removed, and the electrity of the flame itself was exhibited when the two strips were placed, the one above the other, within the flame, with their flat surfaces horizontal, so that they assumed different temperatures. The flame current passed always from the hottest platinum strip through the separating interval of gas to the other strip.

Another attempt was made to ascertain the point at which heated gas permitted the passage of electricity. In the centre of the flame, from a Berzelius's lamp, is a cone-shaped obscure mass of air as yet unburned, but strongly heated by its vicinity to the flame; into this two platinum wires connected with the two cells were introduced from beneath; they were not heated to redness, but the gas nevertheless possessed a weak capacity of conduction. An approximation to the blue rim of the flame showed an increase of conductive power, and a deflection of several degrees was obtained.

When in this case one of the wires was caused to approach the blue edge of the flame, while the other remained at a distance, a deflection of 1° to 2° was obtained after the removal of the two cells; the deflection indicated the passage of a current from the hotter to the cooler wire.

The aperture through which the air passed upwards into the flame was stopped, and thus the dark interior of the flame became formed of the vapor of alcohol and the products of its decomposition; two isolated platinum wires were introduced through the stopping-cork into the central space, but as long as they were kept at some lines distant from the inflamed portion, no trace of electricity passed from one to the other. When they were caused to approach the burning portion, the described phenomena exhibited themselves. In this case also a current was observed to pass from the warmer to the less warm wire through the intervening space of gas.

The author concludes from these experiments, that air and other gases, when heated, and thus rendered conductible, excite electrically bodies plunged in them. Gases thus range themselves in the same list as other conductors of electricity. When two metallic wires, or other conductors which are connected at one end, are brought into contact with a sufficiently heated gas, we have, properly speaking, a closed circuit. If one of the places of contact with the gas be more strongly heated than the other, a thermo-electric current is the necessary consequence.

There is, however, another source of electrical excitation in the flame, as is proved by the following experiment:—One platinum wire was introduced into the obscure centre of the flame, the other was brought near its outer surface; a current immediately exhibited itself, which passed through the flame from the interior to the exterior wire. It continued to pass in the direction even after the outer wire had attained a bright red heat, while the inner one glowed but feebly. It is evident that the thermo-current which would have passed from the hotter to the cooler wire, was in this case overcome by a current, the source of which was the place of contact of the flame and the air. The electricity here developed is so feeble, that the condensing electronometer is better suited to its examination than the multiplying galvanometer. It is easy to see, observes the author, how experimenters who have neglected to separate these two sources of excitation may have arrived at contradictory results.

By properly connecting a platinum wire, which was dipped into the *centre* of the flame, with a condensing plate, the latter became charged with negative electricity, and hence the author concludes that positive electricity is given off by the *outer* surface of the flame. The charging here is exceedingly slow, and can be greatly accelerated when a second wire, which is connected with the other plate of the condenser, is held over the flame.

One end of the galvanometer wire was connected with the platinum wire which dipped into the centre of the flame, the other end of the same was connected with the earth. The current thus obtained was too feeble to cause the slightest motion of the galvanometer needle. But when a spacious platinum dish containing water was brought over the flame and connected with the other end of the galvanometer wire, it required no very sensitive instrument to demonstrate the existence of a current.

"Hence," observes the author, "as the strength of the flame-current by an equal chemical activity and equal conduction of the inner portion of the flame is essentially dependent on the nature of the conduction from its upper portion, it must be conjectured that the formation and carrying away of carbonic acid exercises only a subordinate influence in the matter."

Two pieces of charcoal, one of which is less heated than the other by the flame, deport themselves exactly as a pair of platinum wires under the same circumstances. Silver, copper, brass, and zinc, have also been examined, all of which exhibited the same electrical deportment as platinum when brought into contact with heated air.

The following conclusions are drawn from the experiments above described:—

1. Gaseous bodies which have been rendered conductible by strong heating, are capable of exciting other conductors, solid as well as gaseous, electrically.

2. When a thermo-electric circuit is formed of air, hydrogen or carburetted hydrogen, alcohol vapor, charcoal, or finally a metal, whether combustible or incombustible, an electric current is developed, which proceeds from the hottest place of contact through the air to the less warm place.

3. The development of electricity which has been observed in processes of combustion, and particularly in flame, is due to thermo-electric excitation, and stands in no immediate connection with the chemical process.

4. The products of combustion do not therefore by any means occupy the relation to the burning body which has been assumed by Pouillet; if positive electricity rises with the ascending gases, it is only in the degree in which the burning body and the air exterior to the place of combustion, or rather exterior to the place of hottest contact, are connected by a proper conductor.

ART. XVII.—*Comparison of the modifications of the Osseous structure of the Megatharium with that in other known existing and extinct species of the class Mammalia:* being an abstract of a Memoir read by Professor OWEN, to the Royal Society of London.*

HAVING completed the description of the skeleton of the Megatherium, which was illustrated by an extensive series of accurate and highly finished drawings, the Professor compares the modifications of the osseous structure of this gigantic extinct animal, with that in other known existing and extinct species of the class Mammalia, in the following terms:—

Osseous Structure of the Megatherium, compared with that in other known existing and extinct species of Mammalia.—The teeth agree in number, kind, mode of implantation and growth, with those of the sloth, and their structure is a modification of that peculiar to the sloth tribe. All the modifications of the

* Cited from Jameson's Edinb. Jour., li, 350.

skull relating to the act of mastication, especially the large and complex malar bone, repeat the peculiarities presented by the existing sloths. There are the same hemispheric depressions for the hyoid bone in the Megatherium as in the sloth. In the number of cervical vertebræ the Megatherium, like the two-toed sloth, agrees with the Mammalia generally. In the accessory articular surfaces afforded by the anapophyses and parapophyses of the hinder dorsal and lumbar vertebræ, the Megatherium resembles the ant-eaters (*Myrmecophagæ*); but it does not resemble the armadillos (*Dasypus*) in having long metapophyses, the peculiar development of which, in those loricated *Bruta*, has a direct relation to the support of their bony dermal armor. In the mesozygapophyses of the middle dorsal vertebræ, the Megatherium is peculiar. In the small extent of the produced and pointed symphysis pubis, it resembles the sloths; and in the junction of both ilium and ischium with the sacrum, it manifests a character common to the Edentate order; but in the expanse and massiveness of the iliac bones, it can only be compared with other extinct members of its own peculiar family of Phyllophagous Edentata. Its habits necessitating a strong and powerful tail, we find this resembling, in its bony structure, that of other Edentata with a similar appendage, especially in the independency of the two hæmapophyses of the first caudal, a character which obtains in the great ant-eater and in some armadillos; but this is no evidence of direct affinity to either of these families; the habits of the small arboreal sloths render their eminently prehensile limbs sufficient for their required movements, and the tail is wanting. Had that appendage been proportionally as large as in the Megatherium, we cannot suppose that the caudal vertebræ would have materially differed from those of other Edentata.

In the coalescence of the anterior vertebral ribs with the bony sternal ribs, the Megatherium resembles the sloths. This essential affinity is still more marked in the peculiarities of the scapula and of the carpus. In the *Myrmecophaga jubata* the scaphoid is distinct: in the *Manis* it coalesces with the lunare: in the *Dasypus gigas* the trapezoides is anchylosed to the second metacarpal: in the *Das. sexcinctus* it has coalesced with the trapezium. Not any of these characteristics are manifested by the Megatherium; its carpus repeats the peculiarities of that in the sloths, viz., the reduction of the number of carpal bones to seven, by the coalescence of the scaphoid with the trapezium. The first digit (pollex) which is retained in the ant-eaters and armadillos, is obsolete in the Megatherium, as in the sloths and Orycteropus: three digits are fully developed and armed with claws, as in the *Bradypus tridactylus;* and the fifth, though incomplete in the Megatherium, is better developed, because it was required in the ponderous terrestrial sloth, for its progression on level ground. In

no existing ground-dwelling Edentate is the fifth digit deprived of its ungual phalanx, as in the Megatherium. The bones of the fore foot of that extinct animal are thus seen to be modified mainly after the type of the *Bradypodidæ*.

The long bones of all the limbs are devoid of medullary cavities, as in the sloths. The femur lacks the ligamentum teres, as in the sloths. The fibula is anchylosed to the tibia at both ends in Megatherium, as in *Dasypus;* but this is not the case in the closely allied extinct Megatherioids called *Mylodon*, *Megalonyx*, and *Scelidotherium*, a fact which diminishes the force of the argument which Cuvier deduced from the coalesced condition of the bones in the Megatherium in favor of its affinities to the armadillos. The semi-inverted but firm interlocking articulation of the hind foot to the leg shows the peculiarities of that joint in the sloths exaggerated, and departs further from its characteristics in other Edentata. In all the existing *Edentata*, save the sloths, the hind foot is pentadactyle, and four of the toes have a long claw, even in the little arboreal *Myrmecophaga didactyla;* the departure by degradation from the pentadactyle type is a peculiar characteristic of the sloth tribe in the order. It is carried further in the same direction in the great extinct terrestrial sloths. In these the mutilation of the foot has commenced on the outer side by the removal of the ungual phalanx from the fifth and fourth toes; but this accompanied by modifications, which adapt these toes to the important office of support and progression of the body on level ground. In the scansorial sloths, the three middle digits being equally developed for prehension, one toe on the outer and one on the inner side of the foot are reduced to their metatarsal basis. In the Megatherium, the mutilation of the foot on the inner side is carried to a greater extent; the innermost toe, or hallux, with its entocuneiform bone, is wholly removed; the second toe is represented, like the first in the sloths, by its cuneiform bone, and a coalesced rudiment of the metatarse; and it is only the third toe, or medius, that repeats the condition of the claw-bearing toes in the climbing sloths.

Habits and food of the Megatherium.—Finally, the Professor enters upon the question of the habits and food of the Megatherium. Guided by the general rule that animals having the same kind of dentition have the same kind of food, he concludes that the Megatherium must have subsisted, like the sloths, on the foliage of trees; but that the greater size and strength of the jaws and teeth, and the double-ridged grinding surface of the molars in the Megatherium, adapted it to bruise the smaller branches as well as the leaves, and thus to approximate its food to that of the elephants and mastodons. The existing elephants and the giraffe are specially modified to obtain their leafy food; the one being provided with a proboscis, and the entire frame of the

lofty giraffe adapting it to browse on branches above the reach of its largest ruminant congeners. If the Megatherium possessed, as Cuvier conjectured, a proboscis, it cannot, judging from the suborbital foramina, have exceeded in size that of the Tapir, and could only have operated upon branches brought near its mouth. Of the use of such a proboscis in obtaining nutritious roots, on the prevalent hypothesis that such formed the sustenance of the Megatherium, it is not easy to speculate; the hog's snout might be supposed to be more serviceable in obtaining those parts of vegetables; but no trace of the prænasal bone exists in the skull. A short proboscis would be very useful in rending off the branches of a tree prostrated and within reach of the low and broad-bodied Megatherium, and it would be aided in this act by the tongue, of which, both the hyoid skeleton, by its strength and articulation, and the foramina for the muscular nerves by their unusual area, attest the great size and power.

As regards the limbs, the Megatherium differs from the giraffe and elephant in the unguiculate character of certain of its toes, in the power of rotating the bones of the fore arm, in the corresponding development of supinator and entocondyloid ridges in the humerus, and in the possession of complete clavicles. These bones are requisite to give due strength and stability to the shoulder-joint for varied actions of the fore-arm, as in grasping, climbing, and burrowing; but they are not essential to scansorial or fossorial quadrupeds; the bear and the badger have not a trace of clavicles, and the mere rudiments of these bones exist in the rabbit and the fox. We must seek, therefore, in the other parts of the organization of the Megatherium, for a clue to the nature of the actions by which it obtained its food. In habitual burrowers the claws can be extended in the same plane as the palm, and they are broader than they are deep. In the Megatherium the depth of the claw-phalanx exceeds its breadth, especially in the large one of the middle finger; and they cannot be extended in a line with the metacarpus, but are more or less bent. Thus, although they might be used for occasional acts of scratching up the soil, they are better adapted for grasping; and the whole structure of the fore foot militates against the hypothesis of Pander and d'Alton, that the Megatherium was a burrowing animal. The same structure equally shows that it was not, as Dr. Lund supposes, a scansorial quadruped; for in the degree in which the foot departs from the structure of that of the existing sloths, it is unfitted for climbing; and the outer digit is modified, after the ungulate type, for the exclusive office of supporting the body in ordinary terrestrial progression. It may be inferred from the diminished curvature and length, and from the increased strength and from the inequality of the claws, especially the disproportionately large size of that weapon of the

middle digit, that the fore foot of the Megatherium was occasionally applied by the short and strong fore limb in the act of digging; but its analogy to that of the ant-eaters teaches that the fossorial actions were limited to the removal of the surface soil, in order to expose something there concealed; and not for the purpose of burrowing. Such an instrument would be equally effective in the disturbance of roots and ants; it is, however, still better adapted for grasping than for delving. But to whatever task the partly unguiculate hand of the Megatherium might have been applied, the bones of the wrist, fore-arm, arm and shoulder, attest the prodigious force which would be brought to bear upon its execution. The general organization of the anterior extremity of the Megatherium is incompatible with its being a strictly scansorial or exclusively fossorial animal, and its teeth and jaws decidedly negative the idea of its having fed upon insects; the two extremes in regard to the length of the jaws are presented by the phyllophagous and myrmecophagous members of the Edentate order, and the Megatherium in the shortness of its face agrees with the sloths.

Proceeding then to other parts of the skeleton for the solution of the question as to how the Megatherium obtained its leafy food, the author remarks that the pelvis and hind limbs of the strictly burrowing animals, *e. g.*, the mole, are remarkably slender and feeble, and that they offer no notable development in the rabbit, the Orycterope, or other less powerful excavators. In the climbing animals, as *e. g.*, the sloth and orang, the hind legs are much shorter than the fore legs, and even in those Quadrumana in which the prehensile tail is superadded to the sacrum, the pelvis is not remarkable for its size or the expansion of the iliac bones. But in the megatherium the extraordinary size and massive proportions of the pelvis and hind limbs arrest the attention of the least curious beholder, and become eminently suggestive to the physiologist of the peculiar powers and actions of the animal. The enormous pelvis was the centre whence muscular masses of unwonted force diverged to act upon the trunk, the tail, and the hind legs, and also by the "latissimus dorsi" on the fore limbs. The fore foot being adapted for scratching as well as for grasping, may have been employed in removing the earth from the roots of the tree and detaching them from the soil. The fore limbs being well adapted for grasping the trunk of a tree, the forces concentrated upon them from the broad posterior basis of the body may have co-operated with them in the labor, to which they are so amply adapted of uprooting and prostrating the tree. To give due resistance and stability to the pelvis, the bones of the hind legs are as extraordinarily developed, and the strong and powerful tail must have concurred with the two hind legs in forming a tripod as a firm foundation for the massive pelvis, and

affording adequate resistance to the forces acting from and upon that great osseous centre. The large processes and capacious spinal canal indicate the strength of the muscles which surrounded the tail, and the vast mass of nervous fibre from which those muscles derived their energy. The natural co-adaptation of the articular surfaces shows that the ordinary inflection of the end of the tail was backwards as in a *cauda fulciens*, not forwards as in a *cauda prehensilis*. Dr. Lund's hypothesis, therefore, that the Megatherium was a climber, and had a prehensile tail, is destroyed by the now known structure of that part.

But viewing, as the Professor conceives, the pelvis of the Megatherium as being the fixed centre towards which the two legs and fore part of the body were drawn in the gigantic leaf-eater's efforts to uprend the tree that bore it sustenance, the colossal proportion of its hind extremities and tail lose all their anomaly, and appear in just harmony with the robust claviculate and unguiculate fore limbs with which they combine their forces in the Herculean labor.

The Professor then referred to the *Mylodon robustus*, a smaller extinct species of the same natural family of phyllophagus *Bruta*, and to the additional arguments derivable from the skeleton of that animal in favor of the essential affinity of the Megatherium to the sloths; and the light which the remarkable healed fractures of the skull of a specimen in the Museum of the College of Surgeons threw upon the habits and mode of life of the species.

Hypothesis of the Degeneration of the ancient Megatherioids of South America into modern Sloths, erroneous.—Finally, with reference to the hypothesis of the German authors and artists of the degeneration of the ancient Megatherioids of South America into the modern sloths, the author remarked that the general results of the labors of the anatomists in the restoration of extinct species, viewed in relation to their existing representatives of the different continents and islands, commonly suggested the idea that the races of animals had deteriorated in point of size. Thus, the palmated Megaceros is contrasted with the fallow deer, and the great cave bear with the actual brown bear of Europe. The huge Diprotodon and Nototherium afford a similar contrast with the kangaroos of Australia, and the towering Dinornis and the Palapteryx with the small Apteryx of New Zealand. But the comparative diminutive aboriginal animals of South America, Australia, and New Zealand, which are the nearest allies of the gigantic extinct species, respectively characteristic of such tracts of dry land, are specifically distinct, and usually by characters so well marked as to require a sub-generic division, and such as no known or conceivable outward influences could have progressively transmuted. Moreover, as in England, for example, our moles, water-voles, weasels, foxes, and badgers, are of the same

species as those that co-existed with the mammoth, tichorrine, rhinoceros, cave hyæna, bear, &c., so likewise the remains of small sloths and armadillos are found associated with the Megatherium and Glyptodon in South America; the fossil remains of ordinary kangaroos and wombats occur together, with those of gigantic herbivorous Marsupials; and there is similar evidence that the Apteryx existed with the Dinornis; and the author offered the following suggestions as more applicable to, or explanatory of, the phenomena than the theory of transmutation and degradation. He observed that in proportion to the bulk of an animal is the difficulty of the contest which, as a living being, it has to maintain against the surrounding influences which are ever tending to dissolve the vital bond, and subjugate the organized matter to the ordinary chemical and physical forces. Any changes, therefore, in the external circumstances in which a species may have been created to exist, will militate against that existence, in probably a geometrical ratio to the bulk of such species. If a dry season be gradually prolonged, the large mammal will suffer from the drought sooner than the small one; if such alteration of climate affect quantity of vegetable food, the bulky Herbivore will first feel the effects of the stinted nourishment; if new enemies are introduced, the large and conspicuous quadruped or bird will fall a prey, whilst the smaller species might conceal themselves and escape. Smaller quadrupeds, are usually also, more prolific than larger ones. The actual presence, therefore, of small species of animals in countries where the larger species of the same natural families formerly existed, is not to be ascribed to any gradual diminution of the size of such larger animals, but is the result of circumstances which may be illustrated by the fable of the "oak and the reed,"—the small animals have bent and accommodated themselves to changes under which the larger species have succumbed.

SCIENTIFIC INTELLIGENCE.

I. Chemistry and Physics.

1. *Transmission of Radiant Heat through Crystals.*—Knoblauch has studied the transmission of heat through crystals in different directions with respect to the crystallographic axes. The radiant heat employed was that of the solar rays which were introduced into the room by means of a heliostat; a thermo-multiplier, a Nicol's prism, and cubes cut from various crystals, constituted the only apparatus employed. The principal results obtained were as follows.

(1.) Radiant heat is transmitted through certain crystals, as smoky quartz, beryl, tourmalin, and dichroite, in unequal proportions in different directions, and after transmission exhibits different properties (with re-

spect to diathermanous bodies), according as it has traversed the crystal in one or another direction. These differences are connected with the polarization of heat, and in this respect it is found that

(2.) The transmission of rays of heat perpendicular to the crystallographic axis of rock crystal, beryl or tourmalin, is in a very different proportion from their transmission parallel to the axis, when the plane of polarization makes an angle of 90° with the axis of the crystal. When however the plane of polarization coincides with the crystallographic axis, the rays traverse the crystal in equal proportion in every direction.

(3.) In the former case the qualitative differences are strongly marked; in the latter no such differences are exhibited.

(4.) The rays of heat which traverse the crystal parallel to the axis exhibit no differences, either in respect to their quantity or to their properties, whatever be the position of the plane of polarization, which, with an infinite diversity of position, always passes through the axis of the crystal.

(5.) The rays which have traversed the three last named crystals in different directions perpendicular to the axis, exhibit no difference with respect to each other.—*Pogg. Ann.*, lxxxv, 169.

2. *Mean density of the Earth.*—Reich has published the results of a second series of experiments on the mean density of the earth, undertaken principally with a view of determining the cause of the difference between his own previous results and those of Baily. (It will be remembered that Cavendish found 5·48, Reich 5·45, Baily 5·66.) Three series of experiments, making in all 70 single determinations, were made. The first gave as a mean 5·5712 with a probable error of 0·0113, the second gave 5·6173 with a probable error of 0·0181, the third gave 5·5910 with a probable error of 0·0149. The general result of these three series is 5·5832 with a probable error of 0·0149. The third series was made with a bifilar suspension wire, but the results did not correspond better than those obtained by the single wire. To determine whether magnetic or diamagnetic action interfered with the results, two series of experiments were made, one with a magnetic sphere of iron, the other with a diamagnetic sphere of bismuth. The sphere of iron gave 5·6887 with a probable error of 0·0312; the sphere of bismuth gave 5·5266 with a probable error of 0·0402. It would appear probable that the magnetism of the iron exerted some influence, but none could be attributed reasonably to the diamagnetism of the bismuth.—*Pogg. Ann.*, lxxxv, 189.

3. *Preparation of pure Methylic Alcohol.*—Wöhler has given a very simple and elegant method of preparing pure wood-spirit from the raw material of commerce, which is of interest both to the chemist and pharmaceutist. Raw wood-spirit is to be mixed with an equal weight of sulphuric acid, avoiding an elevation of temperature. The mixture is to be allowed to stand a day, then distilled from two parts by weight of binoxalate of potash. A volatile fluid at first passes over, after which the oxalate of methyl condenses in the neck of the retort. The receiver is now to be changed and the distillation continued as long as the ether comes over. The neck of the retort is then to be gently warmed and the oxalate allowed to flow into the receiver when

it is to be strongly pressed between folds of bibulous paper, and then freed from volatile products by long fusion. In this way it is obtained directly perfectly colorless. The liquid which passes over first contains also oxalate of methyl which is readily obtained by evaporation and crystallization. The pure oxalate of methyl prepared in this manner is now to be distilled with water; pure wood-spirit passes over and oxalic acid remains in the retort. [This method obviously presents great advantages over the tedious processes of Dumas and Kane.]—*Ann. der Chemie und Pharmacie*, lxxxi, 376.

4. *Formation of Sulphuric Acid from Sulphurous Acid and Oxygen.*—Wöhler has published a few observations relating to the formation of sulphuric acid, which, although involving no new principle, promise to be of great importance in a manufacturing point of view. The action of spongy platinum at a high temperature upon a mixture of sulphurous acid and air or oxygen, has long been known. A patent was even granted to Peregrine Phillips for the manufacture of sulphuric acid by this process, the anhydrous acid formed being condensed and united to water in an appropriate receiver. The method was however abandoned as a more extended experience showed that the platinum speedily lost its power of condensation. Wöhler has now found that various metallic oxyds possess in a high degree the property of causing the union of mixed gases. When the oxyds of copper, iron, or chromium, are heated to a low redness in a glass tube and a mixture of sulphurous acid and air or oxygen is caused to pass over them, thick white vapors of anhydrous sulphuric acid are formed. A mixture of the oxyds of chromium and copper prepared by precipitation was found to be particularly efficient; the same quantity of oxyd appeared capable of converting an unlimited quantity of the mixed gases into sulphuric acid, and the production of sulphuric acid was so easy and rapid as to lead to the idea of practical application on a large scale. Metallic copper in a state of powder produces sulphuric acid in a similar manner, but only when heated and when its surface has become converted into oxyd. No hydrate of sulphuric acid is formed by passing the vapor of water over the oxyd at the same time with the gaseous mixture. Platinum foil polished and cleaned acts upon the gaseous mixture like spongy platinum, but not at ordinary temperatures. A mixture of the oxyds of copper and iron prepared by precipitation and ignited, becomes and remains incandescent when warmed and held in a current of hydrogen gas.—*Ann. der Chemie und Pharmacie*, lxxxi, 255.

5. *Constitution of Tannic Acid.*—Strecker has discovered that tannic acid is a copulate of sugar and gallic acid. Tannic acid was boiled with dilute sulphuric acid, the solution was neutralized with carbonate of lead and then precipitated with acetate of lead: after the removal of the lead by sulphydric acid and evaporation, a residue was obtained which proved to be sugar. Strecker considers it probable that the true formula of tannic acid is $C_{40}H_{18}O_{26}$; the resolution of tannic acid into gallic acid and sugar is then represented by the equation,

$$C_{40}H_{18}O_{26}+10HO=2(C_{14}H_8O_{12})+C_{12}H_{12}O_{12}.$$

—*Ann. der Chemie und Pharmacie*, lxxxi, 248.

6. *Products of the decomposition of Hippuric Acid.*—Socoloff and Strecker have studied the action of nitrous acid (NO_3) upon hippuric acid. Nitric and hippuric acids are to be rubbed together in a mortar, the mixture introduced into an appropriate vessel, and a current of deutoxyd of nitrogen passed through till the liquid assumes a greenish hue. Water added in large quantity to the liquid precipitates a crystalline substance, which when purified by recrystallization is represented by the formula $C_{18}H_8O_8$. The authors term this substance benzo-glycolic acid, its formation is represented by the equation.

$$C_{18}H_9NO_6+NO_3=C_{18}H_8O_8+HO+2N.$$

Benzo-glycolic acid is slightly soluble in cold water; hot water dissolves it more easily, but decomposes it gradually. Alcohol and ether dissolve it readily. The analysis of several salts gave the formula of the acid $C_{18}H_7O_7+HO$; it is consequently monobasic like its primitive. In this respect hippuric acid is analcgous to malic and salicylic acids, the amide acids of which are also monobasic. When benzo-glycolic acid is boiled with water containing a small quantity of sulphuric acid, it is decomposed into benzoic acid, and a new acid homologous with lactic acid and which the authors term glycolic acid. The action is represented by the equation

$$C_{18}H_8O_8+2HO=C_{14}H_6O_4+C_4H_4O_6.$$

In its pure state glycolic acid is a syrupy liquid, which does not crystallize. It has a strongly-marked acid taste, and does not give a precipitate with any metallic salt. In its general relations it strongly resembles lactic acid; when however acetate of lead is poured into a solution of glycolic acid and excess of ammonia is added, a white flocky precipitate is thrown down; this is not the case with lactic acid. Glycolic acid may also be obtained by the action of nitrous acid on glycosin (glycocoll), since $C_4H_5NO_4+NO_3=C_4H_4O_6+HO+2N$. Socoloff and Strecker consider it probable that benzo-glycolic acid may be regenerated by the direct union of its constituents. The experiment was not tried from want of material. On the other hand, however, lactic and benozic acids when heated together for some time at 180° till water is no longer disengaged, form a resinous mass which contains an acid, $C_{29}H_{10}O_8$, which the authors call benzo-lactic acid, and which is the homologue of benzo-glycolic acid; the reaction is

$$C_{14}H_6O_4+C_6H_6O_6=C_{20}H_{10}O_8+2HO.$$

7. *New Alcaloid derived from Piperine.*—Cahours has found that when piperine is distilled with from $2\frac{1}{2}$ to 3 times its weight of potash-lime, the product of the distillation consists not merely, as Rochleder and Weitheim have stated, of picoline, but of a mixture of two distinct volatile bases. The most volatile product which forms more than $\frac{9}{10}$ths of the basic liquids boils at exactly 100° C., toward the close of the distillation the thermometer rises, and at 210° again becomes stationary. The more volatile base is a colorless liquid having a strong ammoniacal odor which at the same time recalls that of pepper. It changes vegetable colors from red to blue, has a very caustic taste, and neutralizes the strongest acids. In water it is soluble, and the solution has many of the properties of water of ammonia, with reference to saline solutions; it does not appear, however, to re-dissolve the oxyds of copper and of

zinc. With acids the new base forms numerous perfectly crystallized salts. The constitution of the new base is represented by the formula $C_{10}H_{11}N$, its equivalent volume is 4: Cahours terms it *piperidine*. When iodid of ethyl is brought into contact with piperidine, great heat is evolved, and care must be taken to add but small portions of the ether at a time, and to cool the mixture. A mass of beautiful white crystals is formed, which, when decomposed by potash, yield a new base in the form of a colorless oil, boiling at 128° C., and represented by the formula $C_{14}H_{15}N$ or $C_{10}H_{10}(C_4H_5)N$, an equivalent of ethyl replacing an equivalent of hydrogen. The author terms this base ethyl-piperidine. The iodids of methyl and amyl yield similar compounds with piperidine. Methyl-piperidine boils at 117° C., amyl-piperidine at 186° C. When ethyl-piperidine is mixed with iodid of ethyl, and the mixture maintained for some days at 100° C., a hard crystalline substance is obtained, which may be obtained in beautiful crystals by the evaporation of its solution in alcohol. This compound is the iodid of a new base corresponding to tetra-methyl-ammonium, and tetrethyl-ammonium. Iodid of amyl gives similar results. From the above it appears that piperidine is an imide base, or ammonia in which 2 equivalents of hydrogen are replaced by two equivalents of other radicals. It is possible that these radicals are ethyl and allyl, so that piperidine is represented rationally by NH, C_4H_5, C_6H_5. With bisulphid of carbon piperidine unites to form a crystalline compound: with the chlorid of benzoyl and cumyl the alcaloid gives beautiful crystalline compounds, corresponding to benzamid and cuminamid. Sulphate of piperidine boiled with cyanate of potash gives piperidinurea; the same compound is obtained by passing moist chlorid of cyanogen into piperidine. With chlorine and bromine piperidine gives oily products, which are destitute of basic properties. Cahours does not give the composition of the other base obtained by him in the distillation of piperine. Its boiling point, 210°, does not correspond with that of picoline.—*Comptes Rendus*, xxxiv, 481.

8. *Chemical properties of Electrified Bodies.*—Fremy and Becquerel have published the results of an investigation of the modification of oxygen gas, produced by the action of electricity. These results in the main confirm those of Schönbein, Marignac, and De la Rive, and are as follows:

1st. The decomposition of water by the galvanic battery cannot be successfully employed to investigate the nature of the so-called zone, because the active principle is only produced in very small quantity.

2d. The galvanic arc does not appear to modify oxygen, like the ordinary electric spark, because the elevation of temperature probably destroys the effect which the electricity might produce.

3d. The sparks produced by means of induced current act, like the sparks from the common electrical machine.

4th. Pure oxygen enclosed in glass tubes with paper dipped in starch and iodid of potassium, can be electrized by a succession of sparks, passing over the external surface of the tube.

5th. Oxygen prepared by various methods acquires an odor and very marked oxydizing properties when submitted to the action of electricity. These properties are exhibited in oxygen as pure as it can be obtained.

Electrized oxygen loses its properties when placed in contact with iodid of potassium, but resumes them when again electrized.

These facts demonstrate that the oxydizing power of electrized oxygen, is not due to the presence of any foreign body contained in the gas.

6th. When pure and dry oxygen is enclosed in a series of tubes, and submitted to the action of electricity, it is found that the quantity of gas which becomes absorbable by the alcaline iodid increases during several hours in proportion to the time of electrification, but subsequently appears to diminish, the spark probably destroying the effect which it at first produced.

7th. When small eudiometer tubes were filled with oxygen, and contained at the same time a substance capable of absorbing the electrized gas, as moist mercury, silver, or iodid of potassium, the oxygen was seen to diminish uniformly under the action of the electric spark, and frequently to be completely absorbed.

8th. Tubes containing portions of moist iodid of potassium and of silver, were filled wtth pure oxgen, and then sparks passed through them during several days. The sparks at first very brilliant, became paler and paler, and finally almost invisible. At this moment the tubes were opened beneath the surface of water, when the water instantly rushed in and completely filled the tubes, proving that the oxgen had become completely absorbable in the cold by silver and the alkaline bodies. It was proved that water was not necessary to develop the activity of the oxygen, but only to cause the oxygen to act upon the metal or iodid; also, that the electric spark does not decompose iodid of potassium.—*Comptes Rendus*, xxxiv, 399.

9. *New organic Acid.*—Cloez has separated from the mother liquor of fulminating mercury, a new organic acid, homologous with lactic acid, and to which he gives the name of homolactic acid. Its formula is $C_4H_4O_6$, the general formula of its salts $C_4H_3O_5+RO$. It is a colorless syrupy liquid, and appears to be identical with the glycolic acid of Strecker (vide p. 100, § 6). The distilled products in the preparation of the fulminate contain, according to Cloez, aldehyde, formic, acetic, and nitrous ethers.—*Comptes Rendus*, xxxiv, 363. W. G.

10. *Donarium identical with Thorium*, (L'Institut, No. 957.)—Damour addressed a note to the French Academy at their session of May 3d, stating the results of his investigation of Bergemann's proposed new metal *donarium*.* This substance was extracted by Bergemann from the mineral named *orangite* by Krantz its discoverer, and which mineral was found near Brevig in Norway, the same locality, it will be remembered, which furnished Berzelius with his thorite. Bergemann states that in the orangite, donarium exists with oxygen as a hydrous silicate. He gives 997·4 as the atomic weight of *donarium*, and deduces for its oxyd, with the formula Dr^2O^3, the number 2294·8. The characters ascribed to donarium, and especially the behavior of its oxyd with acids, led Damour to suspect that it might be identical with thorium, and he accordingly made a quantitative analysis of the *orangite*.

* See vol. xii, pp. 280, 387 and 433, of this Journal.

The specimens analyzed were procured from Dr. Krantz of Bonn. The color of this species is orange yellow and its fresh fracture has the resinous lustre and general appearance of the colophonite of Norway. Its density is higher than that of any other silicate at present known. According to Damour, G.=5·19, which is a little less than 5·39, the density given by Bergemann.

The qualitative analysis of orangite indicated that it was essentially a hydrous silicate of *thoria* with small portions of the oxyds of lead, uranium and iron, with lime, alumina, magnesia, potassa and soda. The thoria separated from the orangite presented all the characters which Berzelius in his treatise has assigned to this rare earth. The characters of *donarine*, as given by Bergemann, differ only in two points from those of thoria, viz.: 1st, the smaller density of donarine which M. Bergemann states to be =5·576, while thoria has, according to Berzelius, the specific gravity =9·402; and 2d, the red color which the donarine assumes when calcined. On these two points the results of M. Damour are at variance with those of Bergemann. The density of the earth from orangite, as determined with the greatest care by Damour is 9·366 sufficiently close to 9·402, the density of thoria. The red color is easily accounted for by the presence of the oxyds of uranium and lead which by the methods of Bergemann would remain in the earth extracted from the orangite. Prepared with precaution this earth is obtained perfectly white and has then precisely the same characters as thoria. M. Damour concludes that donarium and thorium are the same, and that the former must be struck from the list of elements.

[It is probable that orangite is identical with thorite: but in the absence of the details of Damour's analysis we can only give the formula deduced from Bergemann's, (this Journal, xii, 433,) viz., $\dot{Th}^3\ddot{Si}+2\dot{H}$, which assumes the oxyd to be Th in accordance with the results of Berzelius. The thorite contains more water than orangite which may be owing to some change in the former, as its lustre is more dull and its density is less, indicating such a change. We speak from the comparison of authentic specimens of the two species obtained from Dr. Krantz.—B. S., JR.]

II. Mineralogy and Geology.

1. *Mines of Sulphurets of Arsenic and Sulphur in Koordistan*, (communicated by Prof. O. P. Hubbard.)—In vol. iii of this Journal (2d series) is a general notice of the existence of sulphurets of arsenic, &c., in Koordistan, ores, which can be purchased in the market of Oroomiah, Persia, and in the bazaars of Constantinople. Dr. Wright of the Oroomiah mission, in a recent letter, gives the following account of the mines.

"We started from Gawar, with the bishop of Gawar for our guide, in the direction of the mines, which are between Bashkullah and Julamerk, about five hours north of the latter place. The second day we crossed the Zab, which here flows through a very deep ravine, and in about two hours from the river reached the little village of Nestorians, called *Goranis*. This is on the mountain side, facing the east, and the mines are on the same mountain, only ten minutes walk from the village.

Leaving our horses we called upon a young Turk, who superintends the mines in behalf of the Turkish government, and drank coffee with him. He and his attendants live in a solitary house on the mountain side.

Accompanied by one of his men we proceeded to the opening of this mine, which is worked by the Koords, in the employ of the Turks. As we reached the place, an old Koord, the head workman, shut the door that closed the entrance and looked as if he would say, 'Here are vast treasures; you cannot enter, or if you enter you must pay me for it.' Having been told that the passage in was so narrow in some places that none could pass except on their hands and feet, creeping through the mud, we turned our backs on the old man and followed a young Greek a few rods down the steep mountain side to the mouth of a mine which had been worked for two years by him and his companion.

On arriving at the entrance we took off our shoes and put on the heavy stout boots of the workmen. Two men entered with us, each one carrying a torch, one before and one behind. We proceeded to the head of the mine, stopping every now and then to examine a rich vein of *sulphuret of arsenic* enclosed in a hard, black rock.

The two sulphurets *realgar* and *orpiment* are usually intermingled, and it is rare that a specimen of either is found alone. The veins vary in thickness from that of a pane of glass to several inches, but the amount in the mine is not large, it being worked mainly with the expectation of reaching a rich deposit farther in the mountain. Since the Turks have subjected Koordistan to their rule, they have taken possession of these mines and are working them at the expense of the government. Some twenty men, Koords and Greeks, are employed in them. The purest sulphurets are put up in loads and sent off to Constantinople, and the inferior kinds are sold to dealers from Persia, where large quantities are used in the baths, combined with lime, to depilate the body.

Sulphur.—A large deposit of sulphur exists about five miles from *Goranis*. There is a large number of sulphur springs where the water gushes out of the ground in a state of violent ebullition.

The sulphur gases (?) are exhaled in abundance, and on holding my face over one of the springs for a moment I was almost suffocated.

While in the mountains we visited Jeeloo, a Nestorian district lying south of Gawar. No part of Koordistan surpasses or equals it in the beauty and grandeur of its scenery. Its lofty peaks and deep ravines and grand gorges are unequalled. One of the peaks is seen in a clear day from the plain of Mosul with the naked eye.

One way led us through a certain gorge, formed as if by the splitting open of a mountain of rock for the passage of the small stream of water.

We were thirty-five minutes in riding through it. Its sides are nearly perpendicular or projecting over our heads, and from 200 to 600 feet in height. The widest place is not more than twenty feet, and in others I could almost touch both sides by reaching out my arms as I rode along. In some parts the sun never shines, and on our return we passed through it between noon and one o'clock, and most of the way we were in the shade."

2. *Mineralogical Notices;* by W. T. Blake.—*Apatite.*—During the past winter a shaft has been sunk upon the vein of crystalline phosphate of lime at Hurdstown, Essex Co., N. Y., and large blocks of massive apatite have been raised; some of the largest of these masses weighed not less than 200 pounds, and were nearly pure apatite,—the specimens have very little color, portions of the masses being translucent and nearly transparent, and resembling the "asparagus-stone" variety of the mineral. The more compact and opaque masses frequently cleave into hexagonal prisms, some of them having lateral planes three inches wide. Rhombohedrons resulting from cleavage are not uncommon.

Brown Tourmaline.—Beautiful transparent crystals of brown tourmaline occur disseminated in the massive and concretionary phosphorite at the "eupyrchroite" locality, Crown-point, Essex Co., N. Y.; terminated crystals are rare, but the few found are highly modified, and are crystallographically similar to the crystals from Gouverneur, N. Y., described and figured by Rose. (See Dana's Mineralogy, p. 136.) The color is a light clove-brown, and the crystals exhibit dichroism. Specimens cut and polished have much beauty as gems.

Red Zinc Oxyd.—Fine cabinet specimens of lamellar red zinc oxyd can be obtained at the zinc mine, Stirling Hill, Sussex Co., N. Y. The lamellar masses are disseminated in the highly crystalline limestone which has frequently a delicate pink hue and translucent,—cleaving readily into large rhombohedrons; the contrast between the red zinc and the gangue adds greatly to the beauty and mineralogical value of these specimens. These distinct nodules of oxyd are found at the junction of the vein of red zinc ore and the limestone, but the oxyd is free from any admixture with franklinite crystals; good crystalline specimens of franklinite are now very rare at the mine.

Molybdate of Lead.—The mineral examined and reported by me as chromate of lead* from the lead mines near Phœnixville, Pa., has since been found to be molybdate of lead, containing *chromic acid.* The crystallographic characters of the molybdate are clearly seen in specimens recently obtained, but in color they much resemble some specimens of chromate.

The mineral I announced as *lievrite*, from the "O'Neil mine," Orange Co., has since been described by Prof. Shepard as dimagnetite.†

3. *Eruption from the summit of Mauna Loa, Hawaii.*—The following highly interesting account of the eruption of the volcanic mountain Mauna Loa, is from the *Polynesian Extra* of March 8th:

The new eruption of Mauna Loa, of which our correspondent, Mr. Sheldon, notified us a few days ago, is likely to prove one of the most extensive that has taken place on these islands within the memory of man. From the last accounts given below, it will be seen that a most sublime spectacle is now to be witnessed on that island, and the end may be the destruction of the beautiful town of Hilo, by the molten river now on its course toward that point.

We give below the letters of our correspondents, which reach down to the 20th ult.

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* This Jour., vol. xiii, p. 116. 1852.

† Ibid. p. 117.

"HILO, February 21, 1852.

DEAR SIR: The old lion is again out of his den, his eyes flash fire and his roar is awful. On the 17th instant, at twenty minutes past 3 A. M., a small beacon light appeared on the summit of Mauna Loa. This light increased until it looked like a rising moon. In half an hour brilliant columns of lava shot up against the heavens, and a general burst of blood red fusion poured out of the same orifice apparently, which disgorged such awful floods in 1843. We were awakened at about four o'clock, and saw a glare of light streaming through our windows. Our first thought was that some building near us was on fire, but on rising we soon perceived that the whole summit of the mountain was irradiated, and that a vast furnace was there glaring with vehement heat. The molten flood rolled down the side of the mountain so rapidly that in two hours we judged its progress to have been fifteen miles, the whole lava glaring with great brilliancy. This flow continued through the day, but with decreasing energy. It becomes sluggish at night, and the next day, or after twenty-four hours, no traces of it were visible from the station; no smoke by day and no fire by night. We had thought of paying a visit to the scene of action; but when the action ceased our pedestrian desires ceased also. Thus we slept.

But our slumbers were soon broken. At six o'clock, A. M., on the 20th, we perceived fire issuing from the side of the mountain towards Hilo, and about half way down the mountain. At first the stream shot directly down towards Hilo; but meeting some obstacle near the foot of the mount, its direction was changed to the north, and it is still flowing towards Mauna Kea.

A vast area between the mountains is already filled with fire, and the scene by night is one of terrible sublimity. The red-hot lava still rolls out of the side of the mountain in awful floods. It seems as if the bowels of Pluto were being disgorged. While I write, our whole atmosphere is filled with lurid smoke, through which the sun looks down upon us with a yellow and baleful light.

The horizon is hung in murky drapery; detonations, like distant thunder, are heard from the mountain, and capilliform vitrifactions are filling our streets. The flood may come down upon us or it may not. On Monday I am off to meet it. It is near the woods.

Monday, 23d.—The eruption is still internally active. The fiery fluid is in the upper region of the woods and the smoke is great. Dr. W. and myself are packed and ready to start for the mountain.

Yours truly, T. COAN."

Another correspondent writes as follows:—

"HILO, February 24, 1852.

Another eruption is now taking place on Mauna Loa. It presents a scene of sublimity unsurpassed. The side of the mountain has opened about midway down the dome, and the lava pours out with unrestrained effort and comes rolling, tumbling and flashing on toward Hilo. It is accompanied with frequent explosions. At night the imagination cannot conceive a spectacle more awfully grand. The immense flow of lava reflects upon the clouds its cherry red hue, and as they gather in density about the mountain, are caught up by the upward current of atmos-

phere, and hurried with rapidity into every imaginable shape, presenting in the heavens a wild picturesque scene. Though the distance from the mountain to the sea seems too far for the lava to flow, it is not impossible, and if it continues to flow for many days as freely as it now does, it is quite probable it will reach the sea somewhere near Hilo."

"HILO, February 26, 1852.

DEAR SIR:—I add a line to the above to inform you that up to this date the action of the late eruption is undiminished. Truly our island is on fire. A line from Mr. Coan informs me that he passed within five or six miles of a stream of lava, yesterday, which was burning its path through the woods, in the direction of Puna. The action on the mountains was more intense last night than it has been since the morning of the 17th. I need not add that we are all deeply interested in knowing when, and where, and how, this fiery flood is to reach the sea. The locality of its source almost precludes the hope that its progress can be as harmless as on a former occasion.

Yours truly, F. COAN."

By advices to Hilo to the 2d inst., we further learn that the stream of lava had burned through the woods to within fifteen miles of Hilo, and that it was still progressing. The current was not so rapid as at first, but it is gradually filling up all the inequalities of the ground, and it was supposed at that date, that it would ultimately reach the sea, and discharge itself into the bay of Hilo.

The light at night was very brilliant, and at Hilo it was almost as light as day. Persons who left this city last week on a visit to Hilo, will arrive at a seasonable moment to witness one of the most sublime phenomena of nature, and one of so rare occurrence that few are fortunate enough to witness it.—*Alta California.*

[According to later accounts the eruption ceased when the stream had reached within seven miles of Hilo.]

4. *On the Structure of the Iguanodon, and on the Fauna and Flora of the Wealden Formation*, (Proc. Royal Institution of Great Britain, March, 1852.)—The geological phenomena of the southeast of England, comprising the lithological characters and organic remains of the Diluvial, Tertiary, Cretaceous, Wealden, and Oolitic deposits, were described in two lectures delivered to the members of the Royal Institution by Dr. Mantell in 1836 and 1849. In those discourses the Fauna and Flora of the *Wealden* were cursorily noticed, and the Iguanodon and other gigantic terrestrial reptiles, whose fossil remains have invested the strata of Tilgate Forest with a high degree of interest, were briefly alluded to. The present lecture was restricted to a consideration of the Fauna and Flora of the countries whence the deposits constituting the Wealden districts were derived; and the osteological characters of the most remarkable fossil Saurians peculiar to this geological epoch, were especially illustrated.

After a concise exposition of the characters of the various formations which have succeeded, and now overlie the Wealden, or in other words, are of more recent origin—namely, the *Drift* or diluvium, containing bones of large mammalia, as the mammoth, mastodon, rhinoceros, horse, deer, &c.;—the *Eocene*, or ancient tertiary strata of the London

basin, abounding in marine exuviæ of special and for the most part extinct types;—and the *Cretaceous* or chalk-formation, comprising the white chalk of the North and South Downs, and the chalk-marl, galt, and greensand, of Surrey, Kent, and Sussex, the whole characterized by innumerable marine shells, zoophytes, fishes, reptiles, &c., of extinct species and genera;—Dr. Mantell proceeded to illustrate the structure of the Iguanodon as exemplified by the isolated parts of the skeleton hitherto discovered, and of which numerous examples were exhibited on the tables of the Institution.

The perfect germ, and the unused tooth, of the Iguanodon, are characterized by the prismatic form of the crown, which is traversed on the thick enamelled face by three or four longitudinal ridges, and has the lateral margins denticulated, and the summit finely crenated; in this state the teeth resemble those of the living *Iguana* of the West Indies,—a resemblance which suggested the generic name of *Iguanodon*. But the fossil teeth are of enormous size in comparison with their recent prototypes; for the teeth of the Iguana are as small as those of the mouse, while those of the Iguanadon are often one inch wide, and three inches in length. Specimens exhibiting the above characters are, however, rare; the summit of the crown is usually more or less worn away by use, and the fang removed by absorption from the pressure induced by the upward growth of the successional teeth. In the first example discovered by Dr. Mantell (in 1820), the crown was ground down so as to present on its inner face a smooth oblique surface with a cutting edge on the summit, and the marginal crenations were worn away; in this state the fossil so strikingly resembled an upper tooth of a Rhinoceros, that Baron Cuvier pronounced it to belong to a species of that genus. Numerous teeth in different stages of growth and detrition were at length obtained, and the reptilian character of the animal to which they belong was satisfactorily determined. Three years since the first specimen of the lower jaw was discovered by Captain Lambart Brickenden, in the same quarry in Tilgate Forest, from which the earliest known tooth was obtained; and subsequently a portion of the upper jaw with teeth, has been procured from the Hastings' strata.

Referring to his various memoirs on the Iguanodon in the Philosophical Transactions, and to his recent work on the Organic Remains in the British Museum,* for details, the lecturer stated, that while the compound structure of the lower jaw, and the mode of dentition, established the reptilian character of the original animal, the maxillary organs presented a nearer approach to those of certain mammalia, than is observable in any other reptiles. The teeth in the upper and lower jaw were arranged in a sub-alternate order as in ruminants; the face of the crown, or that having the thickest coat of enamel, is placed mesially or on the inner side of the lower teeth, and on the external surface of the upper. The anterior part of the lower jaw is edentulous, and its symphysial extremity forms a scoop-like process, which resembles the corresponding part of the inferior jaw of the Edentate mammalia, as

* "Petrifactions and their Teachings, or a Hand-book to the Gallery of Organic Remains of the British Museum," one vol., 1851, published by H. G. Bohn.

for example the *Mylodons:* and the great number and size of the vascular foramina of the jaw, indicate a greater development of the lips, and integuments, than occurs in any existing animals of the class Reptilia; the sharp ridge bordering the deep groove of the symphysis, in which there are likewise several foramina for the exit of nerves and blood-vessels, evidently gave attachment to the muscles and integuments of the lip: while two deep pits for the insertion of the protractor muscles of the tongue, manifest the mobility and power of that organ. There are therefore strong reasons for supposing that the lips of the Iguanodon were flexible, and in conjunction with the long fleshy prehensile tongue, were the chief instruments for seizing and cropping the leaves, branches, and fruit, which from the construction of the teeth we may infer constituted the food of the original. The mechanism of the maxillary organs, as elucidated by recent discoveries, is thus in perfect harmony with the remarkable characters which rendered the first known teeth so enigmatical: and in the Wealden herbivorous reptile we have a solution of the problem, how the integrity of the type of organization peculiar to the class of cold-blooded vertebrata was maintained, and yet adapted, by simple modifications, to fulfill the conditions required by the economy of a gigantic terrestrial reptile, destined to obtain support from vegetable substances: in like manner as the extinct colossal herbivorous Edentata, which flourished in South America, countless ages after the country of the Iguanodon and its inhabitants had been swept from the face of the earth.

The structure of the cervical, dorsal, and caudal vertebræ, of the ribs, the pectoral and pelvic arches, the sacrum formed of six anchylosed vertebræ, the bones of the extremities, and certain dermal appendages, were successfully described, and illustrated by drawings and specimens. From the facts adduced, Dr. Mantell infers that this stupendous reptile equalled in bulk the largest herbivorous mammalia, and was as massive in its proportions; for living exclusively on vegetables, the abdominal region must have been greatly developed. Its limbs were of proportionate size and strength, to support and move so enormous a carcass; its length, as proved by recent disvoveries, was of crocodilian proportions, for there is no doubt that the tail was very long; and the largest Iguanodon may have attained a length of from fifty to sixty feet.

The *Hylæosaurus*, *Megalosaurus*, and several other genera of reptiles were severally noticed, and reference made to the specimens in the British Museum. The *Pelorosaurus* was next described somewhat in detail, and the characters of the stupendous humerus, or arm-bone, (4½ feet long,) scapula, clavicle, vertebræ, sacrum, and pelvis, were pointed out, with the view of illustrating a most interesting discovery made but a few days previously by S. H. Beckles, Esq., of St. Leonard's.

With much labor and skill, Mr. Beckles had succeeded in extracting from a block of Wealden sandstone lying on the Sussex coast, and which was only visible at low water, the perfect *radius* and *ulna* (bones of the fore-arm,) and *humerus*, (arm-bone,) of a gigantic reptile, which Dr. Mantell pronounced to be a *new species of Pelorosaurus*, and proposed to name *Pelorosaurus Becklesii.* The generic *identity* and *specific* difference between this humerus, and that of the *Pel. Conybeari*,

which was placed beside it, were pointed out, and the remarkable modification of structure presented by the *ulna* was explained. The arm-bone of the *P. Conybeari* is 54 inches long, the corresponding bone of a Gavial or gangetic crocodile 18 feet long, in Dr. Grant's Museum, is but 11½ inches; the humerus discovered by Mr. Beckles is 22½ inches in length, and the bones of the fore-arm are 16 inches long. A portion of the scaly cuirass which covered the limbs and is composed of hexagonal plates, were exhibited.

The lecturer then took a rapid view of the other reptiles that were contemporary with the Iguanodon, enumerating the *Pterodactyles* or flying lizards, and several genera of Crocodilians and Chelonians. Examples of marine and fresh-water turtles are not uncommon in the Wealden deposits; and the strata near Swanage have furnished many beautiful specimens to the researches of Mr. Bowerbank.

Of *Fishes* there are nearly forty known species in the Wealden, which are chiefly referable to the *Ganoid* and *Placoid* orders. The fishes most abundant in the rivers of the Iguanodon country were two or three species of *Lepidotus*,—ganoids closely allied to the *Bony* or *Gar-Pike* of America; their teeth and scales are everywhere to be met with in the Tilgate strata.

The *Invertebrate Fauna* comprised many genera of *Insects*, a few *Crustaceans*, and numerous fresh-water *Mollusca*.

Insects.—The *Insects* (for a knowledge of which we are mainly indebted to the scientific acumen of the Rev. P. Brodie) amount to several hundred specimens, comprising between thirty and forty families or genera, and they are referable for the most part to the orders *Coleoptera*, *Orthoptera*, *Neuroptera*, *Hemiptera*, and *Diptera*. Among them are several kinds of beetles, dragon-flies, crickets, May-flies, and other familiar forms which are closely allied to species that inhabit temperate climates.

Mollusca.—The most numerous shells belong to the genera *Cyclas* and *Paludina*. Of the latter, which is a genus of fresh-water snails, there are a few species that abound in the Wealden clays and Purbeck beds, and form extensive strata of shelly limestone, the compact masses of which are susceptible of a good polish and are known by the names of Sussex, Petworth, and Purbeck marble; the latter was in great request in the medieval ages, and is the material of which numerous tombs and monuments, and cluster columns in our ancient cathedrals are constructed. Two common inhabitants of our pools and streams, the Planorbis and Limneus, also occur. Several species of *Unio*, some of which rival in magnitude the pearl-mussels of the Ohio and Mississippi, likewise abound in the Wealden deposits. Fresh-water Entomostraceans, *Cyprides*, of several species, swarm in many of the clays and iron-stone beds of Sussex and the Isle of Wight.

The Flora of the country of the Iguanodon appears to have been as rich and diversified as the Fauna. Forests of *Coniferæ*, referable or closely allied to *Abies*, *Pinus*, *Araucaria*, *Cupressus*, *and Juniperus*, clothed its hills and plains; with these were associated arborescent and herbaceous Ferns, comprising upwards of thirty species; together with many *Cycadeaceæ*, and trees allied to *Dracæna*, *Yucca*, *&c.* Equisitaceous and Lycopodiaceous plants also abounded; and even the com-

mon inhabitants of our streams, the *Charæ*, flourished in the rivulets of that marvellous region.

As examples of the vegetation of the Wealden period, Dr. Mantell described the petrified forest of Coniferæ and Cycadeæ in the Isle of Portland: the accumulation of fossil firs and pines exposed on the southern shore of the Isle of Wight; and the coalfield of Hanover, which entirely consists of the carbonized foliage, trunks, and branches, of coniferous trees, drifted from the country of the Iguanodon.

The facts thus rapidly noticed proved that during the deposition of the Wealden, Oolitic, and Cretaceous strata, there existed an extensive Island or Continent, diversified by hills and valleys, and traversed by streams and rivers teeming with fishes, crustaceans, and mollusca, closely allied to types, which at present inhabit the fresh-water of temperate regions; and that with these were associated fluviatile turtles, and crocodilian reptiles, whose living analogues, are restricted to tropical climes. Colossal herbivorous and carnivorous saurians, differing essentially in structure from all known existing forms, were the principal inhabitants of the dry land; and these, together, with flying lizards, and possibly a few birds, and very small mammalia, constituted the vertebrate fauna of the country or countries, which supplied the materials of the Wealden strata, and of the fluvio-marine deposits which are intercalated with the purely oceanic beds of the Oolite and Chalk.

Thus it appears, according to the present state of our knowledge, that the classes Mammalia and Aves, which constitute the essential features of the terrestrial zoology of most countries, were represented through a period of incalculable duration solely by two genera of very diminutive mammals, and a few birds; while the air, the land, and the waters, swarmed with peculiar reptilian forms, fitted for aërial, terrestrial, and aquatic existence.

Admitting to the fullest extent the effect of causes that may be supposed to have occasioned the absence of mammalian remains in the secondary deposits, the immense preponderance of the reptile tribes is still unquestionable. Some authors have attempted to account for this anomaly by assuming that antecedently to the Eocene period, our planet was not adapted for the existence of mammalia, in consequence of its atmosphere being too impure to support higher types of animal organization than the cold-blooded vertebrata. But the certainty that some forms of marsupial and placental mammalia inhabited the countries of the Megalosaurus and Pterodactyle,—that birds in all probability existed with the Iguanodon,—and the fact that insects and mollusca, and trees, and plants, which now inhabit regions abounding in birds, and mammalia, flourished during the "Age of Reptiles,"—demonstrate that the physical conditions of the earth, and the constitution of the atmosphere, and of the waters, differed in no essential respect from those which now prevail, and that the laws which govern the organic and inorganic kingdoms of nature have undergone no change.

That the class Reptilia was developed during the periods embraced in this discourse to an extent far beyond what has since taken place, appears to be indisputable, nor can any satisfactory solution of the problem be offered from the data hitherto obtained. Future discoveries

may however show that coeval with the country of the Iguanodon there were regions tenanted by birds and mammalia; and that the almost exclusively reptilian fauna of the lands whose zoological and botanical characters have formed the subject of this Lecture, was but an exaggerated condition of that state of the animal kingdom which is exhibited by the present fauna of the Galapagos Islands.*

In conclusion, Dr. Mantell alluded to the recent discovery of reptilian remains (the *Telerpeton Elginense*, and the presumed Chelonian foot-tracks) in the Old Red Sandstone of Morayshire,† in proof of the necessity of bearing in mind the salutary caution of Sir Charles Lyell, "that as our acquaintance with the living creation of past ages must depend in a great degree on what we term chance, we ought never to assume that the first appearance of any type of animals or plants took place at the precise point where our retrospective knowledge happens to stop."

5. *Note on the Fluor-spar locality of Gallatin Co., Ill.;* by G. J. Brush.—Shawneetown, Gallatin Co., Ill., has long enjoyed a reputation among American mineralogists as a locality for fluor-spar. Having had occasion, a few months since, to visit the southern portion of Illinois, I explored this locality. It was found however that the fluor-spar did not occur, as reputed, at Shawneetown, but ten to fifteen miles farther down the Ohio, and a half a mile to a mile north of the river.

The fluor occurs in the carboniferous limestone, it forms numerous veins, many of which are from ten to twenty feet in thickness. It is highly crystalline and often very fetid; beautiful crystallized specimens are found in pockets in the veins, which are sometimes entirely colorless, frequently of a blue, a violet, or a pink tint, and more rarely of an emerald-green.

The localities have been quite extensively worked for lead, which, under the form of galena, is associated with the fluor. The amount of galena is quite considerable, although no regular vein has as yet been found; it is somewhat argentiferous, yielding, on an average of several specimens examined, about four ounces of silver to the ton.

The mining of these veins has developed, besides some fine crystallizations of fluor, as a compact variety in which the associated galena also has the compact structure. An immense amount of a remarkably fine quality of fluor-spar could be obtained from these veins should there be a demand for it in the arts.

Near Rosiclare there are large veins of calcite which have also been worked for lead, in these mines are found finely crystallized specimens of zinc-blende and calcite.

Five miles back from Elizabethtown, in the same county, is an extensive deposit of bog and pipe iron-ore. Two furnaces have been erected near the mine.

Nitre is found about a mile north of the river between Elizabethtown and Rosiclare.

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* See "Wonders of Geology," Sixth Ed., p. 893.

† Lyell's "Manual of Geology," Fourth Ed., p. x.

III. Botany and Zoology.

1. *The Camphor-Tree of Sumatra, (Dryobalanops Camphora.)*—An account of this tree, and of the mode of procuring the peculiar and high-priced *camphor* which it yields, is given by Dr. Junghuhn, who has travelled largely in Sumatra, and Prof. De Vriese, of Leyden, in the *Nederlandsch Kruidkundig Archief*, for 1851. An abstract of the memoir, translated into English by Miss De Vriese, is published in Hooker's Journal of Botany for Feb. and March, 1852. The Dryobalanops is a gigantic tree, rising for fifty or even a hundred feet above those which compose the chief mass of the forests where they grow, just as the steeples of churches appear above the roofs of the houses in a town. The trunks of the full-grown trees are from 7 to 10 feet in diameter at the very base, and from 5 to 8 feet higher up: they rise to the height of 100 or 130 feet, and their ample crown is from 50 to 70 feet in diameter. The tree has a limited range, being confined to the seaward slope of the mountains of south-western Sumatra, most abundant on the lower slopes and the outlying hills of the alluvial plain, and extending in latitude from 1° 10′ to 2° 20′ N. and perhaps farther to the North. *Camphor-oil* occurs in all the trees, and is most abundant in the younger branches and leaves. The solid Camphor is found only in the trunk of the older trees, especially in fissures of the wood, and in smaller quantity than is generally supposed. Colebrooke, and authors who have copied from him, assert that camphor is found in the heart of the tree in such quantity as to fill a cavity of the thickness of a man's arm; and that a single tree yields about eleven pounds. The price of this camphor, which at Padang sells for about $340 per hundred weight, suffices to show that the account is much exaggerated. The camphor occurs only in small fissures, from which the natives, having felled the trees and split up the wood, scrape it off with small splinters, or with their nails. From the oldest and richest trees they rarely collect more than two ounces. After a long stay in the woods, frequently of three months, during which they may fell a hundred trees, a party of thirty persons rarely bring away more than 15 or 20 pounds of solid camphor, worth from 200 to 250 dollars. The variety and price of this costly substance are enhanced by a custom which has immemorially prevailed among the Battas, of delaying the burial of every person who, during his life had a claim to the title of Rajah (of which each village has one,) until some rice, sown on the day of his death, has sprung up, grown, and borne fruit. The corpse, till then kept above-ground among the living, is now, with these ears of rice, committed to the earth, like the grain six months before; and thus the hope is emblematically expressed, that, as a new life arises from the seed, so another life shall begin for man after his death. During this time the corpse is kept in the house, inclosed in a coffin made of the hollowed trunk of a *Durion*, and the whole space between the coffin and the body is filled with pounded camphor; for the purchase of which the family of the deceased Rajah often impoverish themselves. The camphor-oil is collected by incisions at the base of the trunk, from which the clear, balsamic juice is very slowly discharged.

2. *The Chinese Rice-Paper Plant.*—It was long thought that the beautiful and well-known "rice-paper of China was made from the pith of an *Æschynomene:* but this has been shown to be incorrect. Two years ago Sir Wm. Hooker published, in his *Journal of Botany*, some selections from a series of Chinese drawings, representing its manufacture from a strange looking vegetable, which, it now appears, must have been a hoax upon Europeans. For at length Sir Wm. Hooker has obtained, from the island of Formosa, where alone it is known to grow, some imperfect specimens (stems and foliage) of the true plant; from which is made a figure, published in the January number of his Journal; and an account is given in the February number. Enough is now known to render it most probable that the plant is Araliaceous; and it is provisionally named *Aralia? papyrifera*, Hook. The stems are arborescent or frutescent, and are filled with a very large and beautifully white pith, from which the paper is made.

3. *Fungi Caroliniani Exsiccati.*—Sets of specimens illustrating the Mycology of North and South Carolina, are in preparation, we understand, by H. W. Ravenal, Esq., of Black Oak, South Carolina, one of the most zealous and active botanists of our Southern States, and who, incited by the example of Mr. Curtis, has engaged in the study of our Fungi with characteristic energy. He is aided by Mr. Curtis and by the Rev. Mr. Berkeley of England. The first fasciculus, comprising 100 species, nearly half of which are said to be peculiarly American, is announced to be published in the course of the present summer. The publisher is Mr. John Russel, of Charleston, S. Carolina, to whom early application should be made for copies.

4. *Antonio Bertoloni; Miscellanea Botanica;* parts 1–10. Bologna, 1842–51, 4to—with 44 colored plates.—The most important part of this work is an account of the tree that produces *Ebony*, from specimens received from Mozambique. The tree proves to be a *Leguminosea*, on which Prof. Bertoloni has founded a new genus, *Fornasinia ebenifera*, named after the Bolognese merchant, who collected and furnished the specimens. But in *Hooker's Journal of Botany*, the plant is referred to the genus *Millettia*. For us, however, the chief interest of the *Miscellanea Botanica* comes from the descriptions and figures here given of numerous species of plants, founded on a well-known collection made about 20 years ago by Dr. Gates, (here called "Dr. Gaves,") in Alabama. A set of these plants was presented by the Prince of Canino to Professor Bertoloni. Unfortunately Prof. Bertoloni was not aware that the new plants of this collection have been long since published by Nuttall, Torrey, and others; nor is the Italian botanist always happy in referring the plants to their proper genera. Before they find their way into systematic works, it may be well to refer the names here proposed to those generally received in the United States. Thus, Lactuca Alabamensis, *Bert. l. c.* 4, *p.* 10, is L. graminifolia, *Michx.* His Nabalus quercifolius, is N. Fraseri, *DC.*

Hieracium caulophyllum is H. venosum β subcaulescens.

Liatris radians is L. elegans, *Willd.*

Liatris sessiliflora is L. spicata, L. var. β *Torr. & Gr.*

Liatris lanceolata is L. gracilis, *Pursh.*

Liatris umbellata is Vernonia angustifolia, *Michx.*

Eupatorium glastifolium is Liatris odoratissima, *Willd.*
Eupatorium stigmatosum is E. album, *Linn.*
Eupatorium cassinefolium is E. cuneifolium, *Willd.*
Eupatorium racemosum is E. coronopifolium, *Willd.*
Erigeron integrifolium (excl. syn.) is E. vernum, *Torr. & Gr.*
Tussilago oblongifolia is Chaptalia tomentosa, *Vent.*
Aster scabrosus is Sericocarpus tortifolius, *Nees.*
Aster multiflorus is A. dumosus, *Linn.*
Aster microphyllus is A. adnatus, *Nutt.*
Aster rigidus is Diplopappus linariifolius, *Hook.*
Solidago obovata (not figured) is S. pulverulenta, *Nutt.*
Solidago genistoides (not figured) is apparently S. virgata, *Michx.*
Actinomeris alata (not figured) is probably Verbenia Siegesbeckia.
Rudbeckia nudiflora is Helianthus Radula.
Rudbeckia lanceolata (not figured) is probably R. hirta.
Helianthus gracilis is H. heterophyllus, *Nutt.*
Coreopsis callosa (not figured) is C. angustifolia, *Ait.*
Coreopsis heterophylla (not figured) is probably C. aurea, *Ait.*
Coreopsis cuspidata (leaf figured) is certainly C. aurea.
Coreopsis jasminifolia is another form of C. aurea.
Viguiera glandulosa (not figured) must be Baldwinia uniflora!
Gatesia Alabamensis, Nov. Gen. Compos. ("Eadem vero facile ostendit, quam infirma sunt systemata, opus manuum hominum. Dum enim fert habitum plantarum Compositarum, recedit ab iis antheris liberis, forma singulari corollæ, et stylo simplici," etc.) is Petalostemon corymbosum, *Michx.!*
Mariscus aureus is M. echinatus, *Ell.* (Cyperus Baldwinii, *Torr.*)
Cyperus pes-avium is apparently C. dentatus, *Torr.*
Cyperus filicinus, is apparently C. Gatesii, *Torr.*
Cyperus Fontanesii, is C. Nuttalii, *Torr.*
Petalostemon bicolor is P. gracile, *Nutt.*
Tephrosia mollissima is T. spicata, *Nutt.*
Poralea alnifolia and P. alopecurina are Rhyncosia tomentosa, *Torr.*
Clitoria Alabamensis is Centrosema Virginiana.
Lespedeza cytisoides is Pitcheria galactoides, *Nutt.!* with the flowers colored purple; whereas they are said to be yellow in the living plant.
Hedyotis fasciculata is H. purpurea, *Torr. & Gr.*
Diodia auriculosa is a variety of D. Virginica.
Sabbatia simplex is Rhexia stricta, *Pursh.*
Cuscuta remotiflora and C. fruticum, (not figured,) must be left for Dr. Engelmann to determine.
Melanthium biglandulosum, (not figured) is probably Zygadenus glaberrimus, *Michx.*
Euphorbia discolor is E. polygonifolia, *Michx.* non *Linn.* (E. corollata var. ?) A. G.

5. *Outlines of the Natural History of Europe.—The Vegetation of Europe, its conditions and causes;* by Arthur Henfrey, F.L.S. London, 1852, pp. 387, 24mo. Van Voorst.—This is the first of a series of popular works on the Natural History of Europe, undertaken by Mr. Van Voorst; and it is a very interesting one. Mr. Henfrey discusses

first, the General Influences on the distribution of Vegetation, namely the elements of climate in Europe, the soil, &c.; next the Special Influences on the distribution of plants; or the circumstances to which the peculiar vegetation of particular parts of the world may be supposed to be owing, in connexion with the hypothesis of creation at specific centres, (which he adopts) and the varied causes both of the diffusion and of the limitation of species. Then follows a general account of the Vegetation of Europe, treated under ten natural provinces, viz.: The Scandinavian Peninsula; Iceland and the Faroes; The British Islands; The North-European Plain; The East-European Plain; The Central European Highlands; The Alps; The Spanish Peninsula; The Italian Peninsula; The Greek Peninsula. Mr. Henfrey has availed himself of all that has recently been written on this class of subjects, has carefully digested and systematized it, and presented it in a clear and succinct manner. A. G.

6. *Conspectus of the Crustacea of the Exploring Expedition under Capt. C. Wilkes, U. S. N.;* by JAMES D. DANA.—PAGURIDEA, continued, MEGALOPIDEA and MACROURA, (Proc. Acad. Nat. Sci., Philad., 1852. pp. 6-28.)—The genera of Paguridea described in this paper have already been mentioned in this Journal.* The following are the observations on the Megalopidea, together with the descriptions of the new genera, omitting those of the species.

MEGALOPIDEA.—The question of the maturity or immaturity of the Megalopæ and that of their true place in the natural system, still remain in doubt. Without touching on these points, at this time, I propose to describe some new genera and species pertaining to the group.

The species, however diverse, agree in the structure of the abdomen and its caudal appendages; in the position of the four antennæ *between* the eyes; in the articulations of the outer antennæ; in the inner antennæ folded longitudinally or obliquely either side of the beak; in the general form of the outer maxillipeds; in the large size and lateral position of the eyes without orbits; in the general structure of the legs; and in their habits. The beak is either horizontal or flexed downward, and has usually a sharp prominent tooth, either side of it, exterior to the inner antennæ.

The genus Megalopa, *Leach*, as now accepted, embraces two distinct sets of species—the *M. Montagui* and *armata* for which it was instituted by Leach, and the *M. mutica* of Desmarest. The former (the true Megalopæ) have the beak nearly horizontal, with rarely a tooth either side, and there is a reflexed spine on the ventral surface of the first joint of the 8 posterior legs. The latter has the beak bent downward vertically, and either side of it there is a prominent spine or tooth; the ventral surface of the base of the legs is unarmed. The *M. mutica* is very closely related to *Monolepis spinitarsus* of Say, the only difference being that the extremity of the posterior legs in this species of Monolepis bear 3 or 4 setæ rather longer than the tarsus, while the descriptions of the *mutica* make mention of no such setæ. The posterior legs in Monolepis fold up and overlie the carapax: but

* Vol. xiii, p. 121.

these legs are otherwise like the preceding, though somewhat smaller, and it is probable that this habit in the *M. mutica* has been overlooked, as these animals almost always swim with the posterior legs extended like the others, when taken and kept in a jar for examination, and they also have them extended when walking. These legs do not resemble at all the posterior pair in Porcellana or Galathea. I had examined several species before I discovered this habit with regard to the posterior legs. The animal also throws the fourth pair of legs forward along or over the borders of the carapax, so that the extremity overlies the bases of the eyes and the tarsi hang down in front; and at the same time the two preceding pair are folded up and lie against the sides of the carapax outside of the 4th pair, or the third pair may be thrown forward like the 4th. A Sooloo species, and another common off Cape of Good Hope, were observed swimming with the legs thus disposed.

Say's genus Monolepis* also embraces two groups, alike in the deflexed front, and the longish setæ at the extremity of the posterior tarsi. In one division, including the *M. inermis*, the tarsi are flattened styliform, and unarmed, with either lateral edge sparsely furnished with minute hairs; the fossa of the sternum along which the abdomen lies when inflexed, has a prominent trenchant border; the depression on the carapax for the posterior legs is rather abrupt and somewhat neatly defined; the body is very convex and obese, with the sides high and vertical, and much wider behind than before, being gradually narrowed forward.

The other division has the tarsi unguiform, compressed, and spinous below, the antepenult spine always longest; the fossa of the sternum with flaring borders; the depression of the carapax for the posterior legs shallow concave; the body more flattened above, with the sides more oblique. This division corresponds to *Monolepis spinitarsus*.

Besides the preceding, there is another group of Megalopidea, examined by the author, resembling Megalopa of Leach, except that the tarsus of the posterior legs is narrow lamellar instead of unguiculate, and edged with longish setæ somewhat shorter than the tarsus.

There is still another group in which the front is horizontal and tricuspidate, the inner antennæ when retracted being exposed in the interval between the beak or inner cusp and either outer, lying in view as in Plagusia.

With these explanations we give the characters of the genera.

1. Monolepis, *Say.*—Carapax fronte tricuspidatus sed valde deflexus ideoque frons superne visus medio non acutus sed truncatus. Pedes 5ti minores, supe carapacem sæpe restantes, depressione ad eos recipiendos abruptâ; tarsis inermibus, depressis, styliformibus, paris postici non depressis, apice 3—4 setis longiusculis (tarso paulo longioribus) instructo. Sterni fossa abdominalis marginibus bene prominens et subacuta.—*Monolepis inermis*, Say, typus est.

2. Marestia, *Dana.*—Carapax fronte uti in *Monolepi.* Pedes 8 postici ad basin infra non armati; 5ti minores, super carapacem sæpe

* Journ. Acad. Nat. Sci., Philad., i, 155. The author is indebted for the privilege of examining a specimen of Say's *M. inermis*, to Prof. Lewis R. Gibbes of Charleston, S. C. Another related species was obtained by the author in the East Indies.

restantes, depressione ad eos recipiendos parce concavâ : tarsis styliformibus, unguiculatis, spinis infra armatis, paris postici apice setis longiusculis instructis.—Typus est *Monolepis spinitarsus*, Say. Hic pertineret quoque *Meg. mutica*, Desm., si ejus pedes postici setis longiusculis confecti ; aliter genus novum instituendum. Verbum "Marestia" Desmarest commemorat clarissimum.

3. Megalopa. *Leach.*—Carapax fronte simpliciter rostratus, rostro vix deflexo, acuto. Pedes 8 postici ad basin infra uni-spinigeri ; 5ti minores tarso styliformi.—Typus *Meg. Montagui*, Leach.*

4. Cyllene, *Dana.*—Carapacis frons uti in *Megalopa*. Pedes 8 postici ad basin infra uni-spinigeri ; 5ti minores, tarso anguste lamellato, setis longiusculis partim ciliato.

5. Tribola, *Dana.*—Carapax fronte horizontalis, tricuspidatus, rostro (vel cuspide medianâ) tenui, cuspidibus externis vix longiore. Antennæ internæ inter rostrum et cuspides externas apertè inflexæ. Pedes postici minores, tarso unguiculato setisque longis non instructo.

List of new species of Megalopidea described in this paper :—Marestia elegans, M. atlantica, M. pervalida ; Monolepis orientalis ; Cyllene hyalina, C. furciger ; Tribola lata, T. pubescens.

Macroura.—In the account of the Macroura, this tribe is arranged anew, several new genera are added, and 59 new species described. In citing the general remarks, the writer and author here makes a single modification, which consists in removing the Penæus group from the Caridea, and making it a distinct subtribe.

We follow De Haan in placing the genus Galathea with the Anomoura ; and near it we arrange Æglea, which widely differs from most other related species in having penicillate instead of foliose branchiæ.

The Macroura, excluding these groups, includes three distinct sections or subtribes, pertaining to two series.

The *first series* includes the "Fossores" of authors, or the Thalassinidea, which have close relations on one side with the Paguri, and on the other with the Squillidæ. They constitute a line of gradation between these extremes, independent mostly of the other Macroura, and osculating only with the Astaci, although removed from them in general habit and structure. There is a diversity among the legs as to form and position, which is not found in any other Macroura, and calls to mind the Paguri. Moreover, there is in general a looseness of structure, a length of abdomen, and sluggish habit of body, unlike the trim compact forms of the typical Macroura. The anterior feet are thrown directly forward, and are thus fitted for the burrowing habits of the species.

The *second series* embraces the remaining Macroura. There are three grand divisions or subtribes included in the series—a superior, a typical, and an inferior.

The first is somewhat Brachyural in its characteristics, and is made up of the Astacidea. Their relation to the Brachyura and their cephalic

* Malac Pod. Brit., pl. 16. Leach describes three other species (not noticed by Edwards,) in Tuckey's Exped. to the Zaire, (London, 1818,) p. 404. The *M. Cranchii* may be a true Megalopa ; the others have a deflexed beak.

superiority, is seen in the fact that the sides of the carapax fold under and unite to the epistome, a peculiarity well shown in Scyllarus and also, though less perfectly, in Astacus. Another mark of this superiority is observed in the absence or small size of the basal scale of the outer antennæ—this scale existing in no Brachyura, and having a large size in the typical Macroura. The Astaci are the transition species between the Astacidea and the next division of Macroura, and in the genus *Paranephrops* of White, the antennary scale is quite large; the Astaci differ from all the Macroura of the following divisions in the transverse suture which crosses the carapax near its middle.

The remaining Macroura differ from the Astacidea in both of the characters above-mentioned; the carapax is free from the epistome, and the antennary scale is large. They are naturally separated into two sections marked off by the extent of their divergence from the higher Crustacea, and their different degrees of cephalic inferiority. The distribution alluded to is indicated by the position of the strong prehensile legs. In the Brachyura the anterior pair is uniformly the strong pair; and this uniformity through so extensive a group shows that the variations from it must be of importance in classification. This peculiarity of the Brachyura is a consequence of the concentration of force in the anterior portion of the cephalothorax or the anterior nervous ganglia; and the diffusion of this force posteriorly, which in different degrees marks the Macroura, is especially exhibited in the legs.

We observe then that through a large part of the Macroura the strong prehensile legs are either the first or second pairs. These species are all of a common grade; for the species having the first pair the larger are connected by so many transitions with those that have the second pair the larger, that no line of demarcation can be drawn which should make a grand division among them. These are the CARIDEA.

Another group remains, in which the stoutest prehensile legs are those of the *third* pair, and the line between these species and the preceding in this respect is strongly drawn. This peculiarity indicates a transfer of force, which pertained to the first pair in the Brachyura, and to the first or second in the typical Macroura, to a pair more posterior: giving the anterior part of the body a still lower character. These, the PENÆIDEA constitute our third division or subtribe. With the Penæidea should be included certain still lower species, approaching the Mysis group, in which none of the legs are stout chelate, (Sergestes, &c.) whose whole structure indicates their inferior character, and the low state of the forces within.

The three grand divisions, ASTACIDEA, CARIDEA and PENÆIDEA, constituting the second series, thus mark three grades of rank among the Macroura. The Thalassinidea are the *aberrant* species.

These subtribes may be divided into families.

Subtribe 1. *Thalassinidea.*—This section, as Milne Edwards observes, includes two strongly marked divisions; *one*, with only the ordinary thoracic branchiæ, and a *second* with the addition of *abdominal* branchial appendages, as in the Squillidæ. The former we name the *Thalassinidea Eubranchiata*, the latter, the *Thalassinidea Anomobranchiata.* The first group embraces three families, differing strikingly in outer maxillipeds and abdomen, as explained beyond. The second con-

tains only two genera, *Callianidea*, Edw., and *Isæa*, Guerin: the last name was changed by Edwards to *Callianisea*; but as this word is so near Callianassa and Callianidea, a contraction to *Callisea* would be preferable.

Subtribe 2. *Astacidea.*—In this subtribe we adopt De Haan's sections, except that we exclude the Megalopidea, and we do not associate the Thalassinidea with the Astacidea. The sections or families are *Scyllaridæ*, *Palinuridæ*, *Eryonidæ*, and *Astacidæ*.

Leach in 1819 subdivided the old genus Astacus, naming the marine species (Homarus, *Edw.*) *Astacus*, and the fresh water (Astacus, *Edw.*) *Potamobius*. Edwards's division, of like character, now generally accepted, was not published till 1837. Leach hence has the priority. But according to Leach, the name Astacus is appropriated, not to the typical part of the group, that including the *Astacus fluviatilis* of old authors, or *Cancer Astacus* of Linnæus, and which embraces at the present time numerous species, but to that including the *Cancer Gammarus* of Linnæus, still but a small group. There is hence much objection to the names of Leach, and morever much confusion would now ensue from their adoption. There seems, therefore, to be sufficient reason for rejecting them, if it be of no weight that they have remained for 30 years unrecognized by British authors. They are adopted in the Catalogue of British Crustacea of the British Museum, published in 1850, but not in the general Catalogue of 1847.

Subtribe 3. *Caridea.*—In arranging the Caridea into groups, much stress is usually laid upon external form and length of beak. The unimportance of these characters is inferrible from the fact that they involve no essential variations of structure. Moreover, in a single natural group, we may find both the long and short beak. In the Crangon group, for instance, in which the beak is usually very short and the body depressed, we have a species with the beak and habit of an Hyppolyte.

There are other characters of more fundamental value; and these have been brought forward by De Haan. The mandibles afford the distinctions alluded to. In one section they are very slender and are bent nearly at a right angle, without enlargement at the crown. In another they are very stout, and somewhat bent above with a broad dilated crown. In a third, they are stout, but not bent, and have a dentate summit. In a fourth they have, in addition to a projecting lateral crown, a large summit process, which is often oblong and very prominent. These forms are characteristic of different sections of the Caridea.

The fact that the mandibles bear a palpus or not is of much less importance; for the portion of the mandible which is most essential to its functions is the crown.* Among the Palæmoninæ, there are genera having a mandipular palpus, and others without one; while the two kinds in other respects are remarkably close in their relations. We have found moreover, that in this group, the length of the palpus varies with the disjunction of the 2d and 3d flagella of the inner antennæ. If these flagella are separate to their bases nearly, (as in Palæmon,)

* The highest Crustacea have no mandibular palpi.

the palpus is long and 3-jointed; if united for some distance up, the palpus becomes short and finally only 2-jointed (Palæmonella;) if united nearly or quite to their summits, there is no palpus.*

In the arrangement of the genera into families, the fact *whether the 1st or 2d pair of legs is the stouter*, is here of great weight, much greater than has been recognized. By regarding this character, we are led to place Hippolyte and Rhyncocinetes with Alpheus, instead of with Palæmon; also Hymenocera and Pontonia with Palæmon, instead of with Alpheus.

In the preceding paragraphs we have but hinted at some of the more prominent principles involved in the classification of the Macroura here presented, a fuller exposition of which will be given in another place. Below is a synopsis of the families and sub-families thus arrived at, with a description of the new genera.

Synopsis Familiarum Crustaceorum Macrourorum.

Subtribus I. THALASSINIDEA, vel MACROURA PAGUROSQUILLIDICA.

Carapax suturâ transversâ notatus, posticeque sæpe suturis duabus longitudinalibus. Abdomen sæpius multo elongatum. Antennæ externæ squamâ basali sive nullâ sive parvulâ instructæ. Pedes 2 antici prorsum projecti; 6 postici habitu raro consimiles. *Species fossores.*

Legio I. THALASSINIDEA EUBRANCHIATA.

Branchiis instructa thoracicis tantum.

Fam. 1. GEBIDÆ.—Maxillipedes externi pediformes. Appendices caudales et aliæ abdominales latæ.—GENERA: Gebia, *Leach*, Axius, *Leach*, Calocaris, *Bell*, Laomedia, *De Haan*, Glaucothoe, *Edw.*†

Fam. 2. CALLIANASSIDÆ.—Maxillipedes externi operculiformes. Appendices caudales latæ.—GENERA: Callianassa, *Leach*, Trypæa. *D.*

Fam. 3. THALASSINIDÆ.—Maxillipedes externi pediformes. Appendices caudales lineares.—GENUS: Thalassina, *Latr.*

Legio II. THALASSINIDEA ANOMOBRANCHIATA.

GENERA:—Callianidea, *Edw.*, Callisea, (*Guerin,*) *D.*

Subtribus II. ASTACIDEA vel MACROURA SUPERIORA.

Carapax suturâ transversâ sæpius notatus, lateribus anterioribus epistomate connatis. Antennæ externæ squamâ basali sive nullâ sive

* In our genus *Palæmonella*, the palpus of the mandible is 2-jointed, and in *Anchistia*, which is closely like Palæmon in habit in some of its species, there is no palpus, as in the Pontoniæ; and thus the transition to the Pontoniæ from Palæmon is exceedingly gradual. Harpilius and Œdipus (Pontonia of authors) fill up the interval between Anchistia and the true Pontoniæ. They are all similar in having the 2d pair of legs largest, and in other prominent characteristics.

† The genera of living species only are mentioned.

parvâ instructæ. Abdomen sat breve vel mediocre. Branchiæ sæpius penicillatæ. Pedes 2 antici oblique projecti; 6 postici directione consimiles.

1. *Antennæ externæ squamâ basali non instructæ. Pedes antici non chelati.*

Fam. 1. Scyllaridæ.—Carapax valde depressus, marginibus lateralibus sat tenuibus, carapace lateraliter subito inflexo. Antennæ externæ laminatæ, breves. Sternum trigonum.—Genera: Scyllarus, *Fabr.*, Arctus, *D.*, Thenus, *Leach*, Parribacus, *D.* Ibacus, *Leach.*

Fam. 2. Palinuridæ.—Carapax subcylindricus, lateraliter late rotundatus. Antennæ externæ basi subcylindricæ, longæ. Sternum trigonum.—Genera: Palinurus, *Fabr.*, Panulirus, *Gray.*

2. *Antennæ externæ squamâ basali instructæ. Pedes antici didactyli.*

Fam. 3. Eryonidæ.—Carapax non oblongus, depressus, lateribus subito inflexis, abdomine multo augustiore.—Genus: Eryon, *Desm.*

Fam. 4. Astacidæ.—Carapax oblongus, subcylindricus, abdomine parce angustiore. Sternum angustum.—Genera: Homarus, *Edw.*, Astacoides, *Guerin*, (subgen. incl. Astacoides et Cheraps, *Erich.*) Astacus (subgen. incl. Astacus et Cambarus, *Erich.*) Nephrops, *Leach*, Paranephrops, *White.*

Subtribus III. CARIDEA vel MACROURA TYPICA.

Carapax suturâ transversâ non notatus, cephalothoracem plerumque tegens, lateribus anterioribus liberis, epistomate non connatis. Antennæ externæ squamâ basali grandi instructæ. Corpus sive subcylindricum sive paulo compressum. Branchiæ sæpius foliosæ.

Fam. 1. Crangonidæ.—Mandibulæ graciles, valde incurvatæ, non palpigeræ, coronâ angustâ. Pedum pares 1mi 2di inter se valde inæqui.

Subfam. 1. Crangoninæ.—Pedes 1mi 2dis crassiores. Maxillipedes externi pediformes. Digitus mobilis in palmam claudens, immobilis spiniformis. Pedes 2di non annulati.—Genera: Crangon, *Fabr.*, Sabinea, *Owen*, Argis, *Kröyer*, Paracrangon, *D.*

Subfam. 2. Lysmatinæ.—Pedes 1mi 2dis crassiores. Maxillipedes externi pediformes. Manus bene didactylæ. Pedes 2di annulati. Genera: Nika, *Risso*, Lysmata, *Risso*, Cyclorhynchus, *DeH.*

Subfam. 3. Gnathophyllinæ.—Pedes 2di 1mis crassiores. Maxillipedes externi late operculiformes.—Genus: Gnathophyllum.

Fam. 2. Atyidæ.—Mandibulæ crassæ, non palpigeræ, coronâ latâ, parce bipartitâ, processu terminali brevi et dilatato. Pedum pares 1mi 2dique inter se æqui, carpo nunquam annulato.

Subfam. 1. Atyinæ.—Pedes thoracici palpo non instructi.—Genera: Atya, *Leach*, Atyoida, *Randall*, Caridina, *Edw.*

Subfam. 2. Ephyrinæ.—Pedes thoracici palpo instructi.—Genus: Ephyra, *Roux*, *DeH.*

Fam. 3. PALÆMONIDÆ.—Mandibulæ crassæ, sive palpigeræ sive non palpigeræ, profunde bipartitæ, processu apicali oblongo, angusto.

Subfam. 1. ALPHEINÆ.—Pedes 1mi crassiores, chelati; 2di filiformes, carpo sæpius annulati et chelati. Mandibulæ palpigeræ. —GENERA: Alpheus, *Fabr.*, Betæus, *D.*, Alope, *White*, Athanas, *Leach*, Hippolyte,* *Leach*, Rhyncocinetes, *Edw.*,—[Cujus sedis genus Antonomea, *Risso*?].

Subfam. 2. PANDALINÆ.—Pedes 1mi gracillimi; non chelati; 2di filiformes, carpo annulato.—GENUS: Pandalus, *Leach.*

Subfam. 3. PALÆMONINÆ.—Pedes 2di 1mis crassiores, 4 antici chelati, carpis nullis annulatis. Pedes nulli palpigeri. Squama antennarum externarum non acuminata et extus non spinigera. —GENERA *mandibulis non palpigeris:* Pontonia, *Latr.*, Œdipus, *D.*, Harpilius, *D.*, Anchistia, *D.*; *mandibulis palpigeris*, Palæmonella, *D.*, Palæmon,† *Fabr.*, Hymenocera, *Latr.*, Cryphiops, *D.* [Cujus sedis genus Typton, *Costa*, ?]

Subfam. 4. OPLOPHORINÆ.—Pedes 2di crassiores, chelati, 1mi sive didactyli sive vergiformes. Squama antennarum externarum acuminata, extus spinis armata.—GENERA: Oplophorus, *Edw.*, Regulus, *D.*

2. *Maxillipedes 2di tenuiter pediformes.*

Fam. 4. PASIPHÆIDÆ.—Pedes 1mi 2dique chelati. Mandibulæ uti in Atyidis.—GENUS: Pasiphæa.

Subtribus IV. PENÆIDEA, vel MACROURA INFERIORA.

Pedes 3tii majores, 2dis similes; interdum toti debiles et vergiformes. Carapax uti in Carideis.

Fam. 1. PENÆIDÆ.—Pedes 3tii bene didactyli, validiores. Palpus mandibularis latus.—GENERA: Sicyonia, *Edw.*, Penæus, *Latr.* (*Aristæo*, Duvernoy, incluso,) Stenopus, *Latr.*, Spongicola, *DeH.*

Fam. 2. SERGESTIDÆ.—Pedes 3tii 2dique 1mique debiles, obsolete chelati vel non chelati. Palpus mandibularis gracilis.—GENERA: Sergestes, *Edw.*, Acetes, *Edw.*, et forsan Euphema, *Edw.*

Fam. 3. EUCOPIDÆ.—Pedes 3tii 2dique vergiformes, non chelati; 1mi maxillipedesque externi æque monodactyli et subprehensiles, digito in articulum penultimum claudente. Palpus mandibularis gracilis.—GENUS: Eucopia, *Dana.*

New Genera described.

TRYPÆA.—Pedibus *Callianassæ* affinis. Flagella antennarum internarum articulo precedente breviora, antennis supediformibus.

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* Periclimenes, *Costa*, (Ann. dell'Acad. degli Aspir. Nat. di Napoli, ii, 1844) hardly differs from Hippolyte, according to Erichson, Arch. f. Nat. 1846, p. 310.

† *Leander*, Desmarest, (Ann. Ent. Soc., France, 1849, p. 87,) appears to be identical with Palæmon.

Arctus, (Scyllari subgenus 5tum, *De Haan.*)—Rostrum perbreve, truncatum. Antennæ externæ inter se remotæ. Palpus maxillipedis flagello carens. Branchiæ 19. Sp. A. *ursus*, D. (Scyllarus arctus, *Auct.*)

Parribacus.—(Scyllari subgenus 2dum, *De Haan.*)—Rostrum subtriangulatum. Antennæ externæ inter se fere contiguæ. Oculi fere in medio inter antennas internas et angulos cephalothoracis externos. Branchiæ 21. Species, *P. antarcticus* et *P. Parræ* (Ibacus antarcticus et I. Parræ, *Auct.*)

Paracrangon.—Rostrum elongatum. Oculi liberi. Pedes 2di obsoleti, 4ti 5tique acuminati, gressorii.

Betæus.—Rostrum nullum. Oculis et ceteris *Alpheo* plerumque affinis. Manus paris 2di major fere inversa, digito mobili inferiore vel exteriore.—Species maris frigidioris. (*Alphei* manus non inversa et species maris calidioris.)

Pontonia., *Latr. D.*—Corpus depressum. Rostrum breve. Oculi parvuli. Maxillipedes suboperculiformes, articulo 2do lato, 3tio 4toque simul sumtis longiore, his subcylindricis.

Œdipus.—(Pontonia, *Auct.*)—Corpus plus minusve depressum. Rostrum longitudine mediocre. Oculi permagni. Maxillipedes externi latiusculi, articulis totis latitudine fere æquis. Tarsi infra elongatè gibbosi.

Harpilius, (Pontonia, *Auct.**)—Corpus non depressum. Rostrum longitudine mediocre. Oculi magni. Maxillipedes suboperculiformes, articulo 2do lato, 3tio 4toque simul sumtis breviore, his subcylindricis. Tarsi uncinati, infra non gibbosi.

Anchistia.—Rostrum tenue, sæpius ensiforme et elongatum. Corpus vix depressum, sæpe compressum. Oculi mediocres; antennæ duobus flagellis instructæ, unâ parce bifidâ. Maxillipedes externi omnino tenues, pediformes.

Palæmonella.—Corpus non depressum. Rostrum sat longum, dentatum. Oculi mediocres. Mandibularum palpus bi-articulatus perbrevis. Antennæ internæ flagellis duobus confectæ, uno apicem bifido. Maxillipedes externi tenues. (Palpus mandibularis specierum *Palæmonis* tri-articulatus.)

Regulus, *Dana.*—Rostrum longum, dentatum. Antennæ internæ flagellis duobus confectæ. Pedes toti palpigeri, 2 antici non chelati, 2di crassè chelati. Mandibularum palpus 3-articulatus. [Abdominis segmentum 3tium dorso postico instar spinæ productum longæ.]

Eucopia, *Dana.*—Carapax non rostratus, fronte integro. Pedis thoracis elongato-palpigeri, palpis natatoriis. Maxillipedes 2di 3tii et pedes 1mi monodactyli et prehensiles, ungue ad articulum precedens claudente.

The following are the names of the new species:

I. Thalassinidea.—Gebia pugettensis; Callianassa gigas; Trypæa australiensis; Thalassina gracilis.

* Pontoniæ veræ Œdipis et Harpiliis habitu multo discrepant; Pontoniarum oculis parvulis, abdomine valde inflexo, et modo vitæ sæpius Pinnotheroideis: horum oculis pergrandibus, abdomine minus inflexo, animalibus modo vitæ liberis, inter ramos coralliorum sæpe natantibus. Pontonia macrophthalma, *Edw.*, Œdipo pertinet.

II. ASTACIDEA.—Arctus vitiensis; Astacus leniusculus, Astacoides nobilis, Paranephrops tenuicornis.

III. CARIDEA.—Crangon munitus; Paracrangon echinatus; Nika hawaiensis; Alpheus strenuus, A. pacificus, A. euchirus, A. obesomanus, A. crinitus, A. mitis, A. acuto-femoratus, A. parvi-rostris, A. tridentulatus, A. neptunus, A. pugnax, A. diadema, A. malleator; Betæus truncatus; B. æquimanus, B. scabri-digitus; Hippolyte acuminatus, H. exilirostratus, H. obliquimanus, H. brevirostris, H. lamellicornis; Pandalus pubescentulus; Pontonia tridacnæ; Ædipus superbus, Æ. gramineus; Harpilius lutescens; Anchistia gracilis, A. longimana, A. ensifrons, A. aurantiaca; Palæmonella tenuipes, P. orientalis; Palæmon debilis, P. exilimanus, P. concinnus, P. lanceifrons, P. acutirostris, P. equidens; Cryphiops spinuloso-manus; Regulus lucidus, R. crinitus.

IV. PENÆIDEA.—Penæus carinatus, P. avirostris, P. velutinus, P. tenuis, P. gracilis; Stenopus ensiferus; Eucopia australis.

7. *A Monograph of the Sub-class Cirripedia, with Figures of all the Species;* by CHARLES DARWIN, F.R.S., F.G.S. The LEPADIDÆ or PEDUNCULATED CIRRIPEDS. 400 pp. 8vo, with 10 plates. London, 1851. —The Cirripeds, one of the least understood of all the departments of zoology, have fallen into good hands, and this volume of Mr. Darwin, although but the beginning, lays well the foundation of the science, and carries far forward its superstructure. Mr. Darwin recognizes the fact that the Cirripeds are Crustacean in structure. He divides them into three orders—*one*, including the common Cirripeds, and having six pairs of thoracic cirri; *a second*, containing the burrowing genus *Alcippe*, Hancock, and another allied; and *a third*, a peculiar genus (*Proteolepas*, Darwin,) having something of the form together with the sucking mouth of a Lernæan. The first order embraces three families, the *Lepadidæ* or pedunculated Cirripeds, the second *Verrucidæ*, including the genus *Verruca* or *Clisia*, and third, the *Balanidæ;* these last consisting of two distinct sub-families, *Balaninæ* and *Chthamalinæ*. The present work treats only of the Lepadidæ, and contains descriptions and figures of numerous species.

The author traces out the development of the species with much detail, and gives the results of his careful examination into their structure. Two prominent points of interest which he brings forward, are the occurrence of eye-spots, and the relation of the peduncle to the front or anterior part of the head of the young animal. Dr. Leidy's discovery of eyes in a Balanus, led to Mr. Darwin's examination for these organs in the Lepadidæ. The nervous system of the *Lepas fascicularis* consists anteriorly of two large ganglia, (called supraœsophageal by Mr. Darwin) and a chain of thoracic ganglia united by two chords between each. From each of the anterior ganglia, there is a nerve passing to the peduncle, and more interiorly another nerve, which extends to a spot on the median line of a nearly black color, which is the pigment of two united eyes having two distinct lenses. In each of the ophthalmic nerves there is a ganglion a short distance posterior to the eye.

The homology of the peduncle appears to be well made out. The young animal attaches itself by its anterior antennæ when the last

metamorphosis takes place, and although the base of the peduncle may be the analogue of these antennæ, the main part corresponds to the front or cephalic portion of the body, which is elongated.

The Cirripeds are to a great extent hermaphrodites. Mr. Darwin has arrived at many interesting results on this subject, and some that are exceedingly curious. An exception to the general rule of their hermaphroditic character is found in the genus *Ibla*, in which there are true *males*, and the Cirriped proper is simply female. These males lie within the sack of the female Cirriped, and have an elongated body with a slender pedicel below. Although very unlike the female, the organs of the mouth have a similar arrangement, being constructed on the Cirriped type. The cirri are obsolescent; two pair may however be distinguished. That these were true males was ascertained by dissection; and although their parasitic character was questioned, Mr. Darwin traced so many resemblances in the organs that existed to those of the females, that in view of the facts, he concludes, "that the evidence is amply sufficient to prove that the little parasitic Cirriped here described, is the male of Ibla Cummingii." Mr. Darwin has observed further that in the genera Ibla and Scalpellum there are both females and hermaphrodites. And in some hermaphrodites, males have been observed by Darwin, so similar in general character to those of Ibla, that he concludes them to be true males of the species with which they are connected, although the animals are hermaphrodites and not simply females. They are hence called *complemental* males, being supernumeraries. This fact is so anomalous, that Mr. Darwin naturally has been slow in coming to the conclusion that they are not parasites distinct in genus and species. Bearing on this point, it is stated that *Ibla quadrivalvis* is distinguished from *I. Cummingii* by the length of the caudal appendages and the great size of the parts of the mouth; and the so-called males of these species have corresponding differences. So in other characters. Moreover the antennæ have the peculiar hoof-like discs at the extremity characteristic of Ibla and Scalpellum. Taking these and other facts into consideration in connection with the observation that there are true female Iblas that are not hermaphrodites, and with them, these parasites occur with male sexual glands affording spermatozoa and without any trace of ova or ovaries; Mr. Darwin draws the conclusion above mentioned. He closes his remarks on these males with the following observations.

"In looking for analogies to the facts here described, I have already referred to the minute male Lernеidæ which cling to their females,—to the worm-like males of certain Cephalopoda, parasitic on the females,—and to certain Entozoons, in which the sexes cohere, or even are organically blended by one extremity of their bodies. The females in certain insects depart in structure, nearly or quite as widely from the Order to which they belong, as do these male parasitic Cirripeds; some of these females, like the males of the first three species of Scalpellum, do not feed, and some, I believe, have their mouths in a rudimentary condition; but in this latter respect, we have, amongst the Rotifera, a closely analogous case in the male of the Asplanchna of Gosse, which was discovered by Mr. Brightwell* to be entirely destitute of mouth and stomach, exactly as I find to be the case with the

parasitic male of *S. vulgare*, and doubtless with its two close allies. For any analogy to the existence of males, complimental to hermaphrodites, we must look to the vegetable kingdom.

Finally, the simple fact of the diversity in the sexual relations, displayed within the limits of the genera Ibla and Scalpellum, appears to me eminently curious; we have (1st) a female, with a male, (or rarely two) permanently attached to her, protected by her, and nourished by any minute animals which may enter her sack; (2d) a female, with successive pairs of short-lived males, destitute of mouth and stomach, inhabiting two pouches formed on the under side of her valves; (3d) an hermaphrodite with from one to two, up to five or six similar short-lived-males without mouth or stomach, attached to one particular spot on each side of the orifice of the capitulum; and (4th) hermaphrodites, with occasionally one, two, or three males, capable of seizing and devouring their prey in the ordinary Cirripedial method, attached to two different parts of the capitulum, in both cases being protected by the closing of the scuta. As I am summing up the singularity of the phenomena here presented, I will allude to the marvellous assemblage of beings, seen by me within the sack of an *Ibla quadrivalvis*,—namely, an old and young male, both minute, worm-like, destitute of a capitulum, with a great mouth, and rudimentary thorax and limbs attached to each other, and to the hermaphrodite, which latter is utterly different in appearance and structure; secondly, the four or five, free, boat-shaped, larvæ, with their curious prehensile antennæ, two great compound eyes, no mouth, and six natatory legs; and lastly, several hundreds of the larvæ, in their first stage of development, globular, with horn-shaped projections on their carapaces, minute single eyes, filiform antennæ, probosciform mouths, and only three pairs of natatory legs; what diverse beings, with scarcely anything in common, and yet all belong to the same species!"

Mr. Darwin has also published a monograph on the Fossil Lepadidæ of Great Britain—88 pp. 4to, with 5 plates. London, 1851. Printed for the Palæontographical Society.

8. *Dr. A. Binney's Terrestrial Air-breathing Molluscs.*†—* * * In the onward movement of American zoology, conchology has not only occupied a prominent place, but its cultivators have kept it modernized by wisely following the French rather than the English, and one of the results of this has been, for example, that the genus Paludina has been called Helix in English conchological works twenty years after the error had been relinquished forever in France and America—an error so great, that we cannot conceive how it could have maintained its position a single day after its erection as a distinct genus.

Dr. Binney had an excellent general knowledge of conchology and zoology, and in undertaking a complete history of the land Mollusca of this country, he did it with a full appreciation of the difficulties of the

* 'Annals of Natural History' (vol. ii, 2d series, 1848,) p. 153, Pl. vi. Mr. Dalrymple has published a very interesting paper on the same subject, in the 'Philosophical Transactions,' (p. 342,) 1849; and there is another Memoir by Mr. Gosse in the 'Annals of Natural History,' vol. vi, (1850,) p. 18.

† See this Journal, [2], xii, 450.

subject, as well as the mode of investigation, and the general features necessary to bring his work up to the requisitions of science.

The plan included the history of the genera and species; their geographical distribution and synonymy; the figure and description of the mollusc, and an accurate iconography of the shell of each species, (each shell being usually represented by three figures from as many different points of view,) and the special anatomy.

Dr. Binney was a cautious worker and arrived at his conclusions slowly. He employed the best artists, and after the drawings were made, he scrutinized them with great minuteness when comparing them with the original. Among his earlier limners was Mr. Nutting of Boston, distinguished by the minute finish of his work. Subsequently he employed Miss Helen E. Lawson of Philadelphia, and her father as engraver, both of whom had worked upon shells under the direction of the author of another illustrated work on American conchology, already favorably noticed in this Journal. In this preliminary practice the artists were instructed to pay great attention to the direction and curves of the lines of growth, and to draw the more delicate species as translucent objects, by avoiding a deep shade in the aperture of univalves, which would be the result if the light could not enter this part through the shell. The result has shown that a univalve shell may be accurately represented although the shade of the aperture is no darker than that of the exterior, and in the work cited, parts like the curved columella of Physa and Limnea, are represented with an accuracy never exceeded.

The skill acquired in this preliminary practice was transferred to the work of Dr. Binney, and although, from the regularly spiral form of the Helix shell, and the perspective of the lines of growth, it is a difficult object to represent zoologically and artistically, he has had such plates executed as must command the admiration of the naturalist and lover of art.

In addition to the judicious general remarks, the history of a large and well known species, Helix albolabris, is given at length, and the entire work presents such a mass of important matter, and such a complete survey of the field, that (apart from the discovery of new species and detached facts,) it must be considered as exhausting the subject, and we can imagine no contingency which can cause it to be superseded. S. S. H.

9. *Note on Graptolites;* by Dr. H. B. Geinitz, Professor at Dresden (Sax.)—After having submitted all the species of *Graptolites*, published from Linnæus to the end of the year 1851, to a careful investigation, I hasten to give you the last result of my inquiries. The family of the *Graptolithina* contains the following genera:

(1.) *Diplograpsus*, McCoy.* (Syn. *Diprion*, Barrande, *Petalolithus*, Süss.) Graptolithina, with two series of cells separated by a solid axis, (17 species.)

* It is much to be regretted that the old Crustacean generic name *Grapsus* is introduced into another branch of zoology. It would be fully as correct, and as euphonious to write the above names Diplograptus, Cladograptus, &c.; the identity in the names would then be avoided, and the form used in Graptolite at the same time would be retained.—J. D. D.

(2.) *Nereograpsus*, Geinitz. (Syn. *Nereites*, *Myrianites*, *Nemertites*, *Auct.*)—Graptolithina, with two series of cells, without an axis, or with a very soft axis, in the centre of the common canal. (over 7 species.) Representing *Nereites Cambrensis*, Murchison.

N. B. In the specimen of Saalfield in Thuringia I have clearly seen the apertures of the cells.

(3.) *Cladograpsus*, Geinitz.—Graptolithina, with two arms, or forked Graptolithina. (7 species.) Representing *Gr. Murchisoni*, Beck, and *Gr. ramosus*, Hall.

(4.) *Monograpsus*, Geinitz, (Syn. *Monoprion* et *Rastrites*, Barr.) Graptolithina, with one series of cells and a solid axis. (28 species.)

(5.) *Retiolites*, Barrande, (Syn. *Gladiolites*, Barr., *Graptophyllia*, Hall.) Graptolithina, with two series of cells, covered with a fine reticulated membrane, forming a middle axis on one side of the commnon canal. (1 or 2 sp.)

In general, the Graptolithina were characterized by the modes of development and habit of the living Virgulariæ; they were mostly free in the sea, rarely and very likely only in their young state, fixed; others inserted themselves in the mud near the coast. The Graptolithus gracilis, *Hall*, Grapt. Hallianus, *Prout*, and Lophoctenium comosum, *Richter*, I place in the family of Sertularides. The "partie en croissance de Mr. Barrande," or the small part of the most species of Graptolites, is in my view the lower part or the basis of the stem of these animals, and in this I agree with James Hall.

The surface of many Graptolites is metamorphosed very often into *talc*, not into silicious earth, and in the slates of Graptolites he found traces of *iodine*.

Dresden, April 12, 1852.

[Dr. Geinitz has just published on Graptolites, the following elaborate and elegantly illustrated work. Die Versteinerungen der Grauwackenformation in Sachsen. Heft I. Die GRAPTOLITHEN. 60 pp. 4to, with 6 lithog. W. Engelman, 1852. This work contains a review of the species, synonymy and classification of Graptolites.]

IV. ASTRONOMY.

1. *Sixteenth Asteroidal Planet—Psyche*, (Astr. Jour., No. 39.)—A new planet was discovered March 17, 1852, by Prof. De Gasparis at Naples. Its light was equal to that of a star of the 10–11th magnitude; and its position March 17, 1852, $9^h\ 52^m\ 32^s{\cdot}5$, Naples m. t., was R. A. $9^h\ 57^m\ 56^s{\cdot}7$, and N. Decl. $12°\ 51'\ 20''$.

The following elements of its orbit are computed by Mr. G. Rümker of Hamburg, from the Naples observations of March 19 and 29, and the London observation of April 4, which they represent precisely: but they differ widely from elements computed by Mr. E. Vogel.

1852, April, 1·0, m. t. Berlin.

Mean longitude, . . .	280° 25′ 21″·5	
Long. of perihelion, . .	253 56 20 ·8	M. Eqx.
" " asc. node, . .	150 14 11 ·7	Jan. 0·0, 1852.
Inclination, ...	2 43 8 ·1	
Angle of excentricity, . .	7 42 56 ·3	
Log. of semi axis-major, .	0·4965374	
" " mean daily motion, .	2·8052005	

2. *Seventeenth Asteroidal Planet—Thetis*, (Astr. Jour., No. 40.)—A new planet was discovered April 17, 1852, by Mr. Luther, at the Observatory at Bilk, near Düsseldorf. Its light was very faint, and its position at April 17, $10^h\ 37^m\ 39^s$ m. t. Bilk, was R. A. 180° 38′ 24″, and north declination 8° 49′ 2″.

The following elements of the orbit have been computed by Dr. Brünnow of Berlin, from observations of April 17, 21 and 25.

1852, April 17·0, m. t. Berlin.

Mean longitude,	303° 57′ 38″·6
Longitude of perihelion,	259 48 29 ·3
" " asc. node,	124 27 33 ·5
Inclination,	5 37 40 ·9
Angle of excentricity,	7 47 29 ·1
Log. semi axis-major,	0·402348
Mean daily motion,	884″·0650

3. *First Comet of* 1852, (Astr. Jour., No. 41.)—Dr. PETERSEN at Altona, discovered on the 17th of May, 1852, a small telescopic comet in the constellation *Cepheus*. The next night it was discovered independently by Mr. G. P. Bond at the Cambridge Observatory, Mass.

Mr. Bond has published the following elements computed from the observations of May 18, 21 and 25.

Perihelion passage, April 19·5446, Greenwich m. t.

Longitude of perihelion,	280° 17′ 42″	M. Eqx.
" " node,	317 17 54	1852·0.
Inclination,	48 32 0	
Log. of perih. distance,	9·95645	
Motion,	Retrograde.	

4. *Observations on an Auroral Beam, April* 22, 1852.—During the evening of Thursday, April 22, 1852, there was seen at this place (New Haven, Conn.,) a display of the aurora borealis, not very extensive, but yet of much interest, because it presented one phase of the phenomenon well suited for satisfactory observations of parallax.

At about half past seven o'clock there was in the north a shooting of streamers up to an altitude of 20° or 30°, through an amplitude of about 100°. The display soon subsided into a general bright light. On going to the door about twenty minutes after nine, I saw in the northwest a segment of an auroral arc, belt, or beam, entirely isolated, moderately brilliant, having well-defined margins. There was at the time a faint light in the north, but there was no other auroral appearance with which this beam could be confounded. As an opportunity so favorable as this for definite observation on an auroral phenomenon rarely occurs, I endeavored to note its exact position, with the time, and now publish the results in the hope that they may meet the eye of other observers.

At $9^h\ 25^m$ mean time New Haven, the auroral beam stands up from the westerly horizon, about one degree wide, cutting with its southerly edge the star *Castor*, and extending up to and terminating at the star 38 *Lyncis*. There is nothing of the kind visible at a greater altitude, or in the east. Towards the easterly horizon, however, the view is obstructed by clouds and buildings.

The whole beam slowly moved southward, but during the brief period of observation the change of position in the basal portion was scarcely perceptible.

At $9^h\ 31^m$ the southerly edge cuts *mu* and *epsilon Geminorum*, and also *Pollux*. All above the star last named has faded: the sky is becoming hazy in this quarter, and the light of the beam rapidly fading.

During this period the beam has been wholly isolated. There are still some auroral indications on the northern horizon, without any special activity. My time was certain within thirty seconds, and the beam moved so slowly that an error of even a minute would be of little importance. E. C. Herrick.

5. *Auroral Bow of June* 11, 1852.—On the evening of Friday, June 11, 1852, a narrow, serpentine, auroral belt stretching from E. to W., was seen at New Haven, between $9\frac{1}{2}$ and 10 P. M. Observations made at East Windsor Hill, Ct., by Mr. Sereno Watson, compared with those taken here by myself, appear to make it certain that the height of this bow above the earth was not less than one hundred and fifty miles.

E. C. H.

V. Miscellaneous Intelligence.

1. *Remarks on the Climate of San Francisco;* by Dr. H. Gibbons, (from the California Christian Advocate of March 20, 1852.)—In a former article I gave the result of my observations on temperature.* The present chapter refers to the *winds*.

The course of the wind is noted in my journal by three daily entries, viz.: forenoon, afternoon, and evening. Should the wind change during either of these periods, as it very often does, especially in the forenoon, the change is marked, and taken into account in the summing up. With these explanations, the reader will have no difficulty in comprehending the following table, which shows the winds of each month of the year, and the total of the year.

1852.	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.
January, . .	35	2	1	14	7	7	21	6
February, . .	18	5	2	6	9	13	15	16
March, . .	7	2	1	8	4	14	34	23
April, . .	3	5	1	4	7	13	45	12
May, . .	1	1	1	2	4	11	65	8
June, . .	1	1	1	1	5	14	62	5
July, . .	0	0	1	2	1	14	74	1
August, . .	0	1	1	1	6	11	72	1
September, .	1	0	0	2	2	11	72	2
October, . .	8	3	3	6	6	2	54	11
November, .	10	4	2	8	15	12	30	9
December, .	15	9	3	12	24	7	13	10
	99	33	17	66	90	129	557	104

The direction of the coast is nearly N.W. and S.E., or about one point north of N.W., and one point south of S.E. Hence the winds from N.W. to S. inclusive, blow from the ocean, and those from N. to

* See Dr. Gibbons's observations on temperature, vol. xiii, p. 434.

S.E. from the land. The former greatly preponderate, exhibiting an aggregate of 880 observations, to 215 of the latter. That is to say, the winds blew from the ocean semicircle more than three-fourths of the year.

It is still more striking that the winds came from due west, or rather from the octant corresponding to that point, more than half the year; the summing up of that column being 557, against 538 from all other points, embracing seven-eighths of the compass.

Observe the remarkable contrast between the columns of west and east winds, the latter presenting only seventeen observations in the year! It is a well ascertained fact that westerly winds predominate, in the temperate latitudes of the northern hemisphere, on both continents. But I cannot discover that in any other spot on the globe the winds blow from one octant 186 days, and from the opposite octant only six days in the year.

Dividing the year into four seasons, January, February and December being classed as the winter months, we have the following result.

	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.
Spring, . .	11	8	3	14	15	38	144	43
Summer, . .	1	2	3	4	12	39	208	7
Autumn, . .	19	7	5	16	33	25	156	22
Winter, . .	68	16	6	32	40	27	49	32

Thus it appears that the proportion of land winds to sea winds, in the several months, was as follows:—

January,	land winds	52	observations; sea winds	41	observations.
February,	"	31	" "	53	"
March,	"	18	" "	75	"
April,	"	13	" "	77	"
May,	"	5	" "	88	"
June,	"	4	" "	86	"
July,	"	3	" "	90	"
August,	"	3	" "	90	"
September,	"	3	" "	87	"
October,	"	20	" "	73	"
November,	"	24	" "	66	"
December,	"	39	" "	54	"

Grouping the months into seasons, and reducing the observations to days, three observations representing one entire day, we find in the—

Spring,	land winds	12	days; sea winds	80	days.
Summer,	"	3	" "	89	"
Autumn,	"	16	" "	75	"
Winter,	"	41	" "	49	"
Total,	"	72	" "	293	"

In every month of the year the sea winds exceed the land winds, except January, when the reverse occurred. In January, 1852, the land winds were 61 and the sea winds 32. In February, however, the former were but 27 and the latter 60. In December, 1850, the land winds exceeded the sea winds by one observation, the figures standing 47 to 46.

By casting the eye over the tables, one is struck with the progressive increase of the sea winds after the month of January, and the almost entire absence of the opposite winds from May to September inclusive —the land winds in these five months occupying only six days.

The winds from N. and E. are always dry, and in winter cool. They are nearly always attended with a sky of cloudless blue. Those from N.W. to S.W. are cold and chilling at all seasons, and in summer loaded with ocean mists. But they do not often produce rain. The coast winds from S. and S.E. are most conducive to rain, and they are always warm. The course of the winds in relation to rain will be considered under the head of rains.

The force of the winds at different periods of the day, and from different points of the compass, is a subject of some interest. It is represented by figures, 0 indicating calm or nearly calm, 1 a light breeze, 2 a moderate breeze, 3 a strong breeze or wind, 4 a high wind, and 5 a very high wind. The observations occupy three columns, for the forenoon, afternoon and evening. The mean of each of these columns for every month is given in the following table, and the fourth column contains the mean of the three observations collectively, for each month.

	Forenoon.	Afternoon.	Evening.	Mean.
January,	1·21	1·45	·66	1·11
February,	1·45	1·93	1·07	1·48
March,	1·68	2·24	1·40	1·77
April,	1·55	2·32	1·33	1·73
May,	1·77	2·61	1·61	2·00
June,	1·85	2·80	1·92	2·19
July,	1·66	2·97	2·19	2·27
August,	1·45	2·66	1·77	1·96
September,	1·48	2·38	1·28	1·71
October,	·87	2·05	·87	1·26
November,	·85	1·22	·70	·92
December,	1·37	1·32	1·07	1·25
1851,	1·43	2·16	1·32	1·64

The reader will perceive that the average force of the wind in the afternoon was greater than in the forenoon, in every month of the year except December. By referring to my Philadelphia tables, I find there is no uniformity in this respect, the morning winds being stronger in some months and the afternoon winds in others.

The evening winds were uniformly lighter than the afternoon, and lighter than those of the forenoon except in the three summer months, when they were decidedly stronger than in the forenoon. At Philadelphia the evening winds sum up lower in strength than those of the forenoon or afternoon, in every month without exception.

The table shows a remarkable progressive increase in the force of the atmospheric currents from January to July, the latter being the most windy month of the year; and then a decrease till November, the calmest month. At Philadelphia there is no such regularity. Autumn is the calmest season at both places, but summer comes next in the Atlantic States, then winter, and lastly Spring, which is the windiest season on this side of the continent.

From May to September, inclusive, there is more wind at San Francisco than at Philadelphia, but in the remaining five months, from October to April, there is less.

Not only in regard to time do the winds from the western semi-circle greatly preponderate, but also in force. The land winds are often very light and transient, not affecting an ordinary vane. Besides, many of the observations placed in this column in my journal, are due to the influence of the bay, from which a gentle current—really a sea-breeze—frequently flows upon the city for a brief period in the forenoon, before the general current from the ocean sets in from the opposite quarter. These bay currents are strictly local, and on the opposite side of the bay they take the opposite direction, and swell the proportion of sea winds in that location.

The following table is a summary of three daily observations, continued through the year 1851, showing the direction of the atmospheric currents with reference to their comparative force.

	N. & N. W.	E. & N. E.	S. & S. E.	W. & S. W.
Nearly calm, . .	49	24	49	30
Light breeze, . . .	86	39	88	146
Breeze, . . .	69	5	36	335
Wind, ...	20	0	13	191
High wind, . . .	2	0	2	29
Very high wind, . .	0	0	3	1

Thus it appears the wind was very high only three days in the year. Much as is said of the violence of the wind at this place, I have never yet witnessed a wind in California equal to that which frequently attends a thunder-gust or an easterly storm of the highest grade in the Atlantic States.

From the east quarter of the compass, the current did not rise beyond a moderate breeze in the entire year, and only for five observations did it reach that degree of force. As we recede from that limit either northward or southward, the winds increase both in frequency and force. But it is not until we pass the north point on one hand and the S. E. point on the other that they are high. Of the 20 observations above noted as "winds" from N. and N.W., seventeen were from N. W., and only three from N. The two high winds under the same head were from N.W. So, in regard to the 13 winds, 3 high winds, and two very high winds in the column headed S. and S.E; a small proportion were from due S.E., the mass of them coming from S.S.E. and S. The high winds of winter, when such occur, are from this quarter, and bring rain. The high winds of summer are always westerly, and without rain.

In the course of the year there were 169 windy days. On 123 of this number, the wind did not rise till after the sun had crossed the meridian, and it continued after sunset on 57 only. There were but twenty days in the year windy at sunrise.

The sea breeze of summer, which forms the most striking trait of the climate of San Francisco, demands something more than a passing notice, and will be reserved for another chapter, together with the subject of clouds, rains, electrical phenomena, &c.

2. *Remarks on the Winter of* 1851–2 *in Canada, &c.;* by Captain J. H. Lefroy, R.A., F.R.S., (from the Upper Canada Medical Journal, May, 1852.)—The following are extracts from the paper by Captain Lefroy:

Comparison of mean winter temperatures for twenty-one years at Toronto, Mr. Dade's observations with the corrections down to 1840, *being included.*

Table II.

	Nov.		Dec.		Jan.		Feb.		March.		April.		Mean of six months.
	8 A.M.	Mn.	8 A.M.	Mn.	8 A.M.	Mn.	8 A.M.	Mn.	8 A.M.	Mn.	8 A.M.	Mn.	
1830–1	....	...	....	...	17·4	19·4	12·4	15·5	33·2	35·3	41·8	42·9	.....
1831–2	33·4	35·0	12·6	14·6	19·0	21·0	16·7	19·8	28·0	30·1	38·0	39·1	26·60
1832–3	34·0	35·6	28·7	30·7	25·5	27·5	14·6	17·7	23·9	26·9	43·7	44·8	30·37
1833–4	30·9	32·5	28·8	30·8	16·4	18·4	27·3	30·4	30·6	32·7	43·0	44·1	31·48
1834–5	33·5	35·1	23·6	25·6	20·5	22·5	14·4	17·5	27·2	29·3	39·0	40·1	28·32
1835–6	34·0	35·6	21·4	23·4	22·0	24·0	10·9	14·0	20·2	22·3	37·2	38·3	26·26
1836–7	30·7	32·3	23·7	25·7	15·7	17·7	19·5	22·6	22·3	24·4	37·0	38·1	26·80
1837–8	35·7	37·3	26·3	28·3	25·4	27·4	12·8	15·9	32·2	34·3	35·0	36·1	29·88
1838–9	....	...	....	...	....	...	....	...	....	...	....	...	.....
1839–40	33·0	34·6	27·0	29·0	15·0	17·0	26·5	29·6	32·0	34·1	42·3	43·4	31·28
1840–1	34·0	35·9	22·3	24·3	21·8	25·1	18·2	22·6	24·6	27·8	38·3	39·2	29·15
1841–2	34·1	35·3	27·4	29·7	24·7	27·5	24·3	27·5	35·9	36·2	41·2	43·0	33·20
1842–3	31·4	33·1	23·1	25·3	26·6	28·5	11·3	15·0	19·4	21·7	39·2	41·0	27·43
1843–4	31·7	33·1	29·5	30·6	18·0	19·9	24·1	27·3	29·3	31·7	45·6	47·6	31·70
1844–5	32·8	34·8	27·2	28·8	25·3	26·3	24·0	26·8	34·3	35·9	41·4	42·1	32·45
1845–6	35·1	36·7	19·0	21·5	23·9	26·1	16·7	20·8	32·6	33·7	43·4	43·9	30·45
1846–7	39·4	40·8	24·5	27·7	21·9	22·9	19·7	22·5	24·6	26·7	39·1	39·8	30·07
1847–8	37·4	38·7	28·4	30·6	26·2	27·8	24·0	27·0	26·8	29·1	40·7	41·3	32·42
1848–9	....	34·3	....	29·6	....	18·5	....	20·0	....	33·9	....	39·4	29·28
1849–50.....	...	42·3	....	26·9	27·2	29·1	23·1	26·4	28·3	29·6	36·9	38·2	32·08
1850–1	36·5	38·7	20·6	22·5	22·2	25·6	26·5	28·3	30·4	33·1	40·4	41·5	31·62
1851–2	31·0	32·7	20·1	21·6	16·7	18·4	21·1	23·8	25·7	27·8	37·3	38·3	27·10
Mean	....	35·7	....	26·3	....	23·4	....	22·4	....	30·3	....	41·0	29·89

It will be seen that the mean for the *six months* compared is actually the lowest since the winter of 1836–7; and although slightly exceeded in severity by that winter and two earlier ones in the series, the difference in its favor is so trifling, both in that case, and as compared with the winter of 1831–2 that it might possibly disappear, if, instead of deducing mean temperatures, from one observation daily, which in individual months leaves a liability to error to the extent of about one degree, we possessed it from observation. This remark does not apply to the winter of 1835–6, which is said, however, to have been the most severe in North America since 1779–80, and was decidedly more severe than that of 1851–2.

So far therefore, the winter taken in its popular extent, maintains its character, but this results chiefly from our having excluded October, and included April. October 1851 was unusually warm and genial, having had a mean temperature of 47°·8, which is 3°·3 higher than the mean for the same series of years, while April, 1852, has been one of the coldest in it.

It is also remarkable that the lowest mean temperature of the series does not occur in any one month of the past winter, and is only approached by two, November and January: there was no individual month in it nearly so extreme of its kind as December, 1831, January,

1833, February, 1835, and February and March, 1843. The first of these is so very remarkable that but for the privilege Mr. Dade has kindly given me of consulting his original journal, I should have suspected an error. It appears that in this year the cold set in on the 28th of November, and with such severity that the mean temperature at 8 A. M. for three weeks, from the 30th November to the 18th December inclusive was only 10°, which is lower than the *mean* for the same hour for any one winter month at Montreal.

We may next refer to the meteorological winter, or months of December, January and February: the mean of which is given in the following table, together with the lowest temperature at 8 A. M. in each season—the lowest at any hour, and the number of observations which indicated at that hour temperatures below zero, and from zero to 20° in the three months.

TABLE III.

Winter.	Mean temp.	Lowest		No. of Obs. at 8 A.M.		Winter.	Mean temp	Lowest		No. of Obs. at 8 A.M.	
		at 8 A.M.	at any hour.	B'low zero.	Zero to 20°			at 8 A.M.	at any hour.	B low zero.	Zero to 20°
1830–1		-16·0	"	2	38						
1831–2	17·8	-20·0	"	6	61	1842–3....	22·9	- 6·1	-11·0	2	28
1832–3	25·3	- 6·0	"	2	37	1843–4....	25·9	- 7·5	- 8·5	5	16
1833–4	26·5	- 2·0	"	1	35	1844–5	27·3	- 3·6	- 5·5	2	16
1834–5	21·9	-15·0	"	6	40	1845–6....	22·6	- 9·5	-16·2	5	31
1835–6	20·5	-20·0	"	10	43	1846–7....	24·3	1·1	- 2·2	0	33
1836–7	22·0	- 7·0	"	5	39	1847–8	28·5	-11·8 (M)	-12·0	1	19
1837–8	23·5	- 2·0	"	1	"	1848–9....	22·7	-15·2	-15·2	6	27
1838–9	....	....	"	....	"	1849–50 ...	27·5	2·7	- 5·4	0	18
1839–40....	25·2	- 8·0	-19·2	7	"	1850–1	25·5	-12·8	-12·8	2	25
1840–1	24·0	- 2·0	- 8·3	1	34	1851–2....	21·3	-10·6	-14·8	3	34
1841–2	28·2	2·3	- 0·2	0	11						
(M) at 7 A.M.							24·25				

We see that, taken in its meteorological sense, the past winter was less severe than those of 1831–2, and 1835–6, but ranks decidedly among the coldest of the series. In respect to the lowest temperature recorded, it has been often exceeded. The winter of 1831–2 appears to have been the most exceptional of the whole, and it may be mentioned in this connection, on authority of Mr. Paine's observations at Boston, that the winter of 1827–8 was the mildest of the last twenty-seven, it is stated that the Hudson River did not close at all in that winter.

Toronto Bay was frozen over on the 13th December, 1851, and within a day or two of that early date was crossed in sleighs from the neighborhood of the Queen's Wharf. As to the date, it has been frequently frozen as early; in 1835 it was frozen on Dec. 1, in 1845 on the 3d, and in 1840 on the 6th December, but in most, if not all of these cases broke up again. This was not the case in 1851, when it was so solid that as early as December 18, the steamboats found it necessary to land their passengers at the edge of it, half a mile or more beyond that point, and at one time were reduced to landing them with great difficulty and some danger, upon the south side of the Peninsula, by boats; indeed the ice extended in a solid state considerably beyond the

new Garrison, and with a broken margin nearly to the east point of the Humber bay, thus presenting a solid surface almost as far as could be seen from the city; all which are circumstances of very rare occurrence. Although the closing and opening of the bay are affected by accidental circumstances and an uncertain criterion of the character of the winter, the following memoranda on the subject may be interesting; the dates previous to 1840 are extracted from Mr. Dade's valuable notes, and for the subsequent years derived chiefly from memoranda kept for his own information by Serjeant J. Walker, Royal Artillery.

Bay first frozen.	Bay opened.	Bay first frozen.	Bay opened.
1832,	1833, April 4,	1842, December.	1843, April 23,
1833,	1834, March 14,	1843, " 13,	1844, "
1834,	1835, March 30,	1844, " 18,	1845, "
1835, December 1,	1836, April 25,	1845, " 3,	1846, " 8,
1836, "	1837, " 16,	1846, " 15,	1847, " 19.
1837, " 14,	1838, " 2,	1847, " 26,	1848, March 31,
1838, "	1839, "	1848, " 25,	1849, March 29,
1839, "	1840, March 28,	1849, " 26,	1850, April 3,
1840, " 6,	1841, April 12,	1850, " 13,	1851, March 24
1841, " 18,	1842, March 17,	1851, " 13,	1852, April 17'

There is one circumstance, in addition to the state of the thermometer, which very much affects the impressions derived from the senses as to the severity of a winter, namely, the occurrence of high wind with a low temperature; such was the case on many of the coldest days of the past season, particularly in December and January, when a long continuance of searching westerly gales enhanced to a distressing extent the sufferings of those badly provided with fuel, food or clothing. The following are a few examples:—

Table IV.

1851–2.	Temperature. Mean.	Below the average.	Lowest.	Velocity of wind. Mean per hour.	Above the average.	In miles. Highest hour.
				m	m	m
December 25, ...	10·00	15·2	−14·8	8·94	2·74	12·8
" 16, ...	4·78	21·4	− 3·2	10·58	4·38	16·1
" 17, ...	4·93	21·2	1·8	12·27	6·07	17·0
January 20, ...	0·85	21·8	− 3·3	13·47	6·73	17·8
" 19, ...	1·37	21·2	−10·6	10·17	3·44	18·8
" 15, ...	3·75	18·9	− 6·2	7·42	0·68	18·0
" 17, ...	6·77	15·8	2·0	7·59	0·85	14·2
" 22, ...	8·08	14·5	− 0·6	10·26	4·52	14·1
" 13, ...	10·75	11·9	7·0	9·03	2·34	14·2

On every one of these very cold days we have a high wind. With regard to direction, the mean direction, and mean velocity for each of the above months, from five years registration by Robinson's anemometer, and the mean of the same months in the past winter, are given below:

	Mean of 5 years. Direction.	Velocity.	1851–2. Direction.	Velocity.
November, . .	W. 31 N.	4·87,	W. 37 N.	4·70
December, . .	W. 33 N.	6·20,	W. 8 N.	7·37
January, . . .	W. 31 N.	6·74,	W. 30 N.	7·67
February, . . .	W. 39 N.	6·65,	W. 16 N.	6·42
March, . . .	W. 53 N.	6·45,	W. 83 N.	5·81
April, ...	W. 71 N.	6·96,	N. 23 E.	6·68

There was an unusual prevalence of westerly wind to December and February, of northerly in March, and of easterly in April, the other months offer nothing unusual, nor is the quantity of wind excessive in any other month than December and January.

It does not appear from Table III, that any very distinct alternation of mild and severe winters is to be recognized in the period covered by the comparison; on the whole, however, we find that of the last nine winters, six were warmer than the average, and, of the previous nine, six were colder than the average;—this latter period, again, as there is reason to think, was preceded by a series of mild seasons, so that there are some grounds for supposing that we may now expect a succession of the opposite character; but, it is evident, that a very cold winter frequently occurs in a warm series, and a mild one in a cold series. Of the former character may have been that of 1809–10, which by this rule should fall in a warm group, although it will long be remembered by the old inhabitants of Canada, for the memorable *black night*, the 18th January, 1810, in which the temperature changed in a few hours from a high thermometer, with rapid thaw, warm and genial sunshine, to the most intense frost, producing distress and devastation unparalleled in their recollection. There are probably in existence some precise notes taken on this remarkable occasion, but I have not been able to hear of them.

3. *Region of Lake Superior.*—Dr. J. J. Bigsby recently delivered a lecture before the Royal Institution of London on the Geography and Geology of Lake Superior. Dr. B. was well qualified for that duty, from personal acquaintance with the regions around the great lakes, on which he made valuable observations that were communicated many years ago to the Geological Society of London, and were published in their Transactions. His summary is interesting and instructive. We have room only for the following citations:

"The chief staple of Lake Superior is native copper. For ages before the appearance of Europeans in America, this metal was supplied from hence to the Indian nations far and near. The tumuli of the Mississippi, &c., contain the beautiful copper of this lake. Traces of ancient mining in Kewenaw, Ontonago and Isle Royal are abundant, in the form of deep pits, (a ladder in one,) rubbish, stone mauls, hammers, wedges, and chisels of hardened copper. In a native excavation near the river Ontonagon, with trees five hundred years old growing over it, lately lay a mass of pure copper eighty-one tons in weight, partly fused, and resting on skids of black oak."

The miners, forty in number, are assisted by steam power. Silver is always present, and sometimes in masses of considerable size. There are now in the Cliff mine masses of pure copper within view, estimated to weigh seven hundred tons. On the lands of the Minnesota company there is one block that weighs two hundred and fifty tons.

In 1851, sixteen hundred tons of copper were shipped, valued at £130,000.

4. *A New Fuel.*—Some curious experiments have been made at the Polytechnic Institution to test the results of a recent invention of Dr. Bachhoffner, for which patents have been obtained by the inventor and

Mr. N. Defries. The invention consists in the substitution of thin pieces of metal in the place of coals in fire-grates—which being acted on by a small jet of gas, immediately become red-hot, and emit a prodigious degree of heat. The flame which is produced by the proper, but very simple management of the gas co-operating with the metallic laminæ, gives the appearance of a brisk and cheerful coal-fire, and can scarcely be distinguished from it. The heat can be regulated by turning the cock of the gas tube. There is no deposit of soot, no smoke, nor any of the annoyances which attend coal-fires, and the gas can, it is said be extinguished *instanter*, or the fire kept as low as may be convenient.—*Athen.*

5. *Abstract of Meteorological Observations made at Attleboro', Mass.*, in lat. 41° 59′ 22″, long. 71° 22′ 45″, *for the year* 1851; by Henry Rice.

Months.	Means of the Barometer.*						Means of attached thermometers.				
	Sunrise.	9 A.M.	1 P.M.	4 P.M.	Range.	Monthly mean.	Sunrise.	9 A.M.	1 P.M.	4 P.M.	Monthly mean.
January,..	29·733	29·751	29·751	29·754	1·62	29·747	42·90	49·29	57·50	58·61	52·075
February,	29·910	29·921	29·905	29·855	1·27	29·904	41·18	48·82	52·25	56·07	49·580
March, ...	29·760	29·769	29·760	29·772	·96	29·790	49·13	57·97	60·96	63·08	57·784
April, ...	29·696	29·731	29·706	29·625	1·05	29·695	51·10	56·90	59·00	62·10	57·275
May, ...	29·795	29·806	29·794	29·791	·79	29·796	56·31	60·80	64·40	67·71	62·305
June, ...	29·734	29·747	29·731	29·726	·65	29·744	61·96	63·50	67·90	71·30	66·165
July, ...	29·663	29·687	29·635	29·668	·60	29·663	69·20	69·40	74·30	75·90	72·200
August, ..	29·791	29·807	29·796	29·790	·53	29·796	62·70	65·90	70·40	74·00	68·250
Septemb'r,	29·875	29·897	29·877	29·858	·78	29·815	63·03	63·10	67·57	70·57	66·065
October, ..	29·736	29·754	29·738	29·728	1·04	29·739	57·90	63·90	66·90	68·60	64·325
November,	29·706	29·727	29·654	29·647	1·59	29·683	46·00	50·47	52·63	55·53	51·160
December,	29·736	29·753	29·725	29·723	1·08	29·734	43·60	48·80	49·90	51·70	48·500
Ann. mean.	29·761	29·779	29·756	29·745	·99	29·760	53·75	58·23	61·98	64·60	59·064

Months.	Means of External Thermometer.									
	Sunrise.	9 A.M.	1 P.M.	4 P.M.	Mean.	Range.	Min.	Max.	Coldest day.	Warm'st day.
January, ...	21·96	28·00	36·23	32·20	29·60	63	−8	55	31	26
February, ...	25 16	31·18	38·21	36·57	32·78	61	−5	56	8	15
March, ...	29·86	39·46	45·28	44·53	40·17	66	12	78	14	31
April, ...	36·67	48·37	53·77	52·30	47·80	43	23	66	17	24
May, ...	45·70	59·56	67·56	65·47	59·58	55	31	86	5	28
June, ...	52·77	68·00	74·20	75·40	67·59	61	37	98	7	30
July, ...	61·27	75·33	81·10	78·66	73·92	49	46	95	29	17
August, ...	55·70	70·80	79·37	78·10	70·93	48	44	92	37	8
September, ..	51·26	62·76	71·46	69·83	64·08	60	31	91	25	11
October,.....	44·90	56·20	63·90	60·70	56·15	49	30	79	27	12
November, ..	30·40	36·13	43·03	40·00	37·39	42	16	58	11	2
December,...	19·03	23·65	31·90	27·42	25·52	57	−4	53	26	31
Ann. mean.	39·557	49·962	57·167	55·099	50·484	1·06				

The warmest day in the year was the 30th of June, the mean heat of which was 87·5°; the coldest day was the 31st of January, the mean of which was 2·5°.

* Altitude of barometer above tide water at Providence 175 feet;—diameter of tube ·12 inches. The readings of the barometer have not been corrected for temperature, sea-level or capillary action. The entire range of the barometer during the year was 1·71 inches.

Months.	Clearness, from 0 to 10.				Winds.—No. of times the wind was observed to be in the							
	Sunrise.	9 A.M.	1 P.M.	4 P.M.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.
January, ...	4·6	5·4	5·1	5·4	14	3	2	8	19	23	28	27
February, ...	4·3	4·7	4·4	4·7	14	6	3	6	29	10	17	27
March, ...	4·7	5·3	4·1	4·4	13	14	3	4	26	17	12	35
April, ...	5·5	5·3	4·6	4·8	21	27	6	7	18	5	11	25
May, ...	5·3	4·7	4·3	4·6	15	10	6	8	34	17	13	21
June, ...	5·9	7·0	6·5	6·4	14	7	4	6	29	15	25	20
July, ...	5·7	5·5	4·3	5·0	13	12	3	2	31	30	17	16
August, ...	6·0	6·4	5·8	5·5	13	6	3	3	35	24	13	27
September, ..	5·7	6·1	5·7	6·1	32	10	7	6	29	9	15	12
October, ...	4·7	5·5	4·8	5·4	13	7	6	13	28	14	14	29
November, ..	5·1	4·6	4·3	4·0	21	5	1	5	7	17	15	49
December, ...	5·8	6·2	5·3	5·8	9	3	1	8	12	17	12	62
	5·3	5·6	4·9	5·2	192	110	45	76	297	198	192	350

As a Meteorological Register has never before been kept in this town, I am unable to compare these results with those for any previous years. The location where the above observations were made, is at North Attleboro', on the Boston and Providence turnpike, twelve miles north of the latter place.

The robin, (Turdus migratorius,) blackbird, (Quiscalus ferrugineus), and bluebird, (Sialia Wilsonii,) appeared Feb. 24th; wild goose, (Anser canadensis,) March 14th. The frogs "gave their first concert for the season," March 25th.

The elm, (Ulmus americanus,) in blossom, April 1st; cowslip, (Caltha palustris,) 6th; anemone, (Anemone nemorosa,) 10th; skunk cabbage, (Symplocarpus fœtidus,) 20th; wild columbine, (Aquilegia canadensis,) May 1st; currant, (Ribes rubrum,) 5th; common pear, (Pyrus communis,) 10th; lilac, (Syringa vulgaris,) 15th; flowering almond, (amygdalus nana,) 12th; apple, (Pyrus malus,) 15th; buckthorn, (Rhamnus cathartica,) 17th; horse-chesnut, (Æsculus hippocastanum,) 20th; flowering dogwood, (Cornus florida,) 24th; large blue flag, (Iris versicolor,) 29th; yellow pond lily, (Nuphar advena,) 31st; trumpet creeper, (Bignonia radicans,) June 3d; spider-wort, (Tradescantia virginica,) 5th; common locust, (Robinia pseud-acacia,) 10th.

There was a display of the *aurora* on the evenings of the following days, viz., Jan. 19. 21, 23; Feb. 18; March 23, 29; May 1; Sept. 6, 8, 16; Dec. 19, 23, 29.

6. *Nees von Esenbeck*, (from the Phytologist, a London botanical Journal, No. cxxx, March, 1852, pp. 465–467.)—We are glad to find that we are not singular in sympathizing with the unfortunate Nees von Esenbeck, a man whose only fault it is to hold opinions contrary to those of the party which has acquired the ascendancy in Germany. Our able contemporary, Hooker's Journal of Botany, in announcing to its readers that M. Nees von Esenbeck had been requested to continue as President of the L. C. Academy of Naturalists, and that he had assented, continues: "This mark of respect towards one of the most classical and distinguished botanists of the age, who during a long series of years has contributed vastly to the celebrity of the Academy, will be hailed not only by its own members, but by every lover of natural science." Such generous expressions are highly creditable, both

to the journal in which they appear, and the writer from whose pen they issue, and cannot but comfort the illustrious philosopher to whom they refer.

Most of our readers are aware that M. Nees von Esenbeck, is the victim of the political reaction on the continent, but few know the unfeeling manner in which he has been persecuted. M. Nees von Esenbeck has always been the friend of true freedom—for who can be a thinking man without being so?—and has so much enjoyed the confidence of his countrymen that a few years ago, he was elected member of Parliament. His eloquence, his sound reasoning, and the warmth with which he spoke, soon gave him influence in the Assembly, so much so that he became the leader of the popular party. He always remained faithful to his colors; and when so many deserted the cause which they had advocated, when oaths were violated as soon as uttered, and treaties broken before the ink was dry, M. Nees von Esenbeck was true to his principles; and neither bribery nor threats produced any effect upon him. Venerable for his age, distinguished as a philosopher, and eloquent as an orator, it was evident that the influence of such a man was to be feared. Moreover, he was no hero behind the barricades; he had been legally elected, and conducted his discussions with prudence and propriety, and strictly within the bounds of parliamentary license. But as silence was thought indispensable, M. Nees von Esenbeck was suddenly suspended in his functions as Professor in the University of Breslau, and reduced to circumstances of the most distressing nature. An excuse for this arbitrary act, however, was thought necessary; and as despotism is never in want of arguments, however sophistical, to give a coloring to its proceedings, a domestic misfortune rather than a fault of M. Nees von Esenbeck's former life was taken for that purpose; and at an advanced age of nearly eighty, the venerable old man was punished for an act that happened twenty years before, and which, according to the laws of the country, must have been very slight indeed, to remain so long without being investigated. That public opinion has not been misguided in this matter is evident. M. Nees von Esenbeck had not only been re-elected President of one of the most ancient academies in the world, but men are everywhere stepping forward who endeavor to place him above the want to which the sudden loss of his situation has exposed him. Naturalists of eminence are, we understand, selling portions of their collections, in order to give the proceeds to the illustrious *savant*. We ourselves have been requested by several of our correspondents to open a subscription for his benefit, and we are only too glad to become the humble medium by which that great and good man may be benefitted. Having obtained permission from M. Nees von Esenbeck himself, we are ready to receive any sums, however trifling, to acknowledge them in our Journal, and afterwards in periodicals of a wider circulation.

It would be trifling with the cause we are pleading, were we to attempt to write a panegyric upon a man so unfortunate. A person who is eighty years of age, and in want, not only of the mere comforts of life, but the bare means of subsistence, and who has devoted his whole life and all he possessed to the advancement of science, is indeed worthy of consideration. Entomology, ornithology, botany, and many

other branches of learning are indebted to him for some of the most important additions. He has always been ready to assist others whenever he was called upon; and there are many naturalists in Great Britain who have enriched their volumes with his labors. As a teacher he has done an immense deal. His lecture-rooms were always the most crowded, and subjects which, in the hands of others, appeared dry, insipid, and dull, his eloquence knew how to make interesting and charming. There are few who have ever seen him on the platform who can forget the impression which his lectures produced; the sparkling eye, the animation, and clearness of explanation never failed to produce most favorable effects. His labors as an author are numerous, and show great erudition and research. They belong to that class of writing which freed natural history from the pedantic sway of the Linnæan school, and fairly applied the light of philosophy to the investigation of organized beings. Indeed, M. Nees von Esenbeck is one of the remaining few who conclude the circle of illustrious men who raised natural science to the rank it now holds, and in which the names of Jussieu, DeCandolle, Göthe, and Link, not to mention any living ones, stand preëminent.

We have also been requested to prepare an address, and now have the pleasure of submitting the following one to the consideration of our readers. Whoever would wish to sign it is invited to send his name to our office, (9 Devonshire street, Bishopgate, London.) Previous to the delivery of the document we will cause the names, arranged alphabetically, to be printed in some of the journals of the widest circulation both at home and abroad.

TO M. NEES VON ESENBECK, PRESIDENT OF THE L. C. ACADEMY OF NATURALISTS.

Mr. President: The undersigned have learned, with feelings of the deepest regret and sorrow, that you have been suspended in your functions as Professor of the University of Breslau; that a man whom they have always regarded as one of the most classical, has suddenly been arrested in the pursuit of those investigations which have been productive of such invaluable results to science. It falls to the lot of but few to make, at an advanced age, those treasures available which a life of constant application and incessant study have enabled them to accumulate. You, Mr. President, are by the grace of Providence, still in possession of those faculties which allow you to add to the brilliant achievements and important labors of which your whole career has been an uninterrupted series. How painful then, becomes the reflection, that what God has granted, man has cruelly prohibited, and, by depriving you of those means essential to existence is about to bury for ever your vast amount of knowledge, and consign you, as it were, alive, to a premature grave. Keenly as we feel your misfortune, still more keenly do we feel our inability to alleviate it. Our voice of sympathy is the consolation we can offer; and we declare that, uninfluenced by the slanders with which malignity has overwhelmed you, we still remember your name with gratitude and respect; and, deaf to the arguments with which envy and hatred have attacked you, we still look

upon you as the great philosopher who has raised for himself in the field of science a monument, which neither the violence of parties nor the lapse of time are capable of overturning.

[We have received also an advertisement of the Herbarium of Nees von Esenbeck, which is on sale, from which we cite the following.—*Eds.*]

The Herbarium includes about 340 volumes, besides 57 volumes in duplicate. It is arranged in the main in accordance with Lindley's Natural System of Botany, 2d edition. The value of the whole is estimated at 12,000 rix thalers, or about 30 rix thalers per volume. The whole number of species included is between 34,000 and 40,000, and each volume contains between 100 and 120 species. The species are from all parts of the world, Asia, the Indies, New Holland, Tropical America, &c.

List of the volumes and their contents.* The price is given in rix thalers, each worth about 72 cts.

	No. of vols.	Price in Thalers.
1. Ranunculaceae,	3	90
2. Magnoliaceae, Winteraceae, Anonaceae, Schizandraceae, Dilleniaceae, Myristicaceae,	1	
3. Papaveraceae, Fumariaceae, Nymphaeaceae,	1	
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7. Myrtaceae, Philadelphaceae, Hamelidaceae, Cornaceae, Loranthaceae,	1	
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* Orders may be sent through Edward Pelz, Georgetown, D. C., (care of Professor John C. F. Salomon.)

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26. Leguminosae,	9	600
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28. Amyridaceae, Anacardiaceae, Cupuliferae, Betulaceae, Scepaceae,	1	
29. Urticaceae, Ceratophyllaceae,	1	
30. Ulmaceae, Stilaginaceae, Myricaceae, Juglandaceae, Casuariaceae, Datiscaceae, Saururaceae,	1	
31. Piperaceae,	2	120
32. Salices, Platanaceae,	5	150
33. Callitrichaceae, Santalaceae, Elaeagnaceae, Thymelaeaceae, Hernandiaceae, Aquilariaceae, Proteaceae,	1	60
34. Lauraceae,	7	560
35. Illigeraceae, Cassytaceae, Penaeaceae, Nepenthaceae, Aristolochiaceae,	1	60
36. Amarantaceae,	1	
37. Chenopodiaceae, Tetragoniaceae, Phytolaccaceae,	1	
38. Polygonaceae, Petiveriaceae, Scleranthaceae, Nyctaginaceae, Menispermaceae, Brexiaceae,	1	
39. Pyrolaceae, Monotropaceae, Ericaceae, Vaccinieae, Epacridaceae,	1	
40. Primulaceae, Myrsinaceae,	1	
41. Convolvulaceae,	1	
42. Sapotaceae, Ebenaceae, Styraceae, Aquifoliaceae, Nolanaceae, Cuscutaceae, Polemoniaceae, Hydroleaceae,	1	
43. Lobeliaceae, Campanulaceae, Stylidiaceae, Goodeniaceae, Scaevolaceae,	1	
44. Cinchonaceae,	2	
45. Caprifoliaceae,	1	240
46. Galiaceae,	1	
47. Compositae,	23	800
(2000 Species.)		
48. Dipsaceae, Valerianaceae, Brunnoniaceae, Plantaginaceae, Globulariaceae, Salvadoraceae,	1	
49. Plumbaginaceae, Hydrophyllaceae, Cordiaceae, Ehretiaceae, Boraginaceae,	1	
50. Labiatae,	6	180
51. Veronicaceae,	2	60
52. Lentibulariaceae, Scrophulariaceae,	1	
53. Orobanchaceae, Gesneriaceae, Sesamaceae, Selaginaceae,	1	
54. Verbenaceae, Myoporineae, Stilbaceae,	1	
55. Bignoniaceae, Cyrtandraceae, Pedaliaceae,	2	90
56. Acanthaceae,	19	1300
57. Solanaceae, Cestraceae,	5	300
58. Gentianaceae, Sigeliaceae,	1	
59. Apocynaceae, Asclepiadaceae, Loganiaceae, Potaliaceae, Oleaceae, Jasminaceae,	1	
60. Gnetaceae, Cycadaceae, Coniferae, Taxaceae,	2	
61. Equisetaceae,	1	
62. Scitamineae, Marantaceae, Musaceae, Haemodoraceae,	1	
63. Iridaceae, Bromeliaceae, Hydrocharaceae,	1	
64. Orchidaceae, Vanilleae,	2	120
65. Palmaceae, Pontederaceae, Melantaceae,	1	
66. Liliaceae,	2	60

	No. of vols.	Price in Thalers.
67. Commelinaceae, Butomaceae, Alismaceae, Philydraceae, Smilaceae, Dioscoraceae, Roxburghiaceae, Pandanaceae, Cyclanthaceae,	1	
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69. Glumosae, including Gramineae, 46 vols., Cyperaceae, 21 vols., Restiaceae, 5 vols., Junceae, 2 vols., =	74	2400
70. Balanophoreae,	1	60
71. Filicales, in all,	8	300
500 Species.		
72. Cellulares,	84	2400
Besides 57 packages and 30 volumes in Duplicate.		

APPENDIX.

I.

73. The Wallichian collection of East Indian plants,	9	540
74. New Holland plants by Preiss,	7	420

II.

75. Sieber, Plantae insulae Trinitatis,	2	60
76. Sieber, Plantae insulae Mauritii,	2	60
77. Plantae Mexicanae,	2	120
78. Plantae Brasilienses, still undetermined,	1	60
79. Plantae Americanae, " "	1	30
80. Plantae Wightianae,	5	1400
(According to the Catalogue 2403 Species.)		
84. Plantae Javanicae, still undetermined,	3	180
85. Ibid.	1	60
86. Plantae Javanicae mixtae,	1	60
87. The same in large form,	1	30
88. Florula Zeylanica,	1	10
89. Plantae Abyssinicae,	1	20
90. Plantae Novae Hollandiae dubiae,	1	30
91. Plantae exoticae mixtae, indeterminatae,	1	60
92. Plantae aliquot Florae mixtae,	1	20
93. Florula Vilnensis,	1	2
94. Plantae Italicae,	1	5
95. Florula Sickershusensis,	1	1

7. *Prices of Microscopes made to order, by* I. & W. GRUNOW, Opticians, 54 Pacific street, Brooklyn, L. I.—No. 1. Large compound microscopes, mounted on a stout brass tripod box and uprights; body with quick and slow motion; 2 corrected Huyghenian eye-pieces and $\frac{1}{4}$th inch object-glass; the moveable stage is 4 inches square, the concave mirror is 3 inches diameter, $105.

No. 2. The same size instrument mounted on a Japaned cast-iron stand, all dimensions and actions same as above, $85.

A solid upright mahogany case for do., $8; of cherry-wood, $7.

No. 3. Instrument No. 1, smaller size, stage 3 by 4 inches, concave mirror 2 inches diameter, $85.

No. 4. The same size instrument, with Japaned cast-iron stand, 1 eye-piece and $\frac{1}{4}$ inch object-glass, $52.

No. 5. Ditto with plain stage, $40.

No. 6. Ditto sliding motion to the body, $35.

Solid upright case of cherry-wood for No. 3, 4, 5, and 6, $5–6.

No. 7. Portable achromatic compound microscope for travelling, mounted on three folding-legs, with quick and slow motion, the moveable stage is 3 by 4 inches, concave mirror, 2½ inches, with 2 eye-pieces and ¼ inch object-glass, packed in a flat mahogany case, $85.

No. 8. Best single microscope with all improvements, 4 object-glasses, varying from 1 inch to ⅛ inch, packed in a small flat mahogany case, to the top of which it is mounted when in use, $40.

No. 9. Ditto, simpler, with the same powers, $32–35.

A small compound body with 1 eye-piece, and ¼ inch-object glass, is supplied with No. 8 and 9 additional, $15–20.

All accessory instruments and apparatus, as well as additional object-glasses, and eye-pieces made to order at moderate prices.

[Messrs. Grunow's instruments are in mechanical structure unsurpassed.—*Eds.*]

8. *American Association for the Advancement of Science.*—The next meeting of this Association will be held at Cleveland, Ohio, commencing with the third Wednesday in August (Aug. 18). Professor Peirce of Harvard is President for the session and ensuing year.

9. *Gold of California.*—The total shipment of gold from San Francisco for April, 1852, was $3,419,847, for March, $2,549,704.

VI. Bibliography.

1. *Steam-Boiler Explosions:* Memorial of Samuel Guthrie, a Practical Engineer, submitting the results of an investigation made by him into the causes of the explosion of steam-boilers. 32d Congress, U. S., 1st Session, Senate, No. 32, Miscellaneous.—This is an excellent document, from an experienced man, who makes no pretensions to being more than he is, a skillful practical engineer. Mr. Guthrie has devoted many months to a careful investigation of all the causes of disaster in steam-boilers on the navigable waters of the United States. He has examined personally nearly all the steamboats on the Ohio and Mississippi, and has had the opportunity of seeing several boats just after they had exploded. We need not dwell on the preëminent importance of the adoption without delay of certain and efficient means of avoiding a class of accidents which no warning from past experience nor check of existing laws have prevented from increasing with the rapid extension of our immense inland commerce. In our opinion the conclusions and suggestions of Mr. Guthrie if adopted, with suitable legal guards and penalties, would reach the difficulty and totally prevent these frightful accidents so destructive to human life. After a careful review of the whole subject, Mr. Guthrie presents the following "Recapitulation."

Recapitulation of the principal causes tending to produce explosions of steam-boilers.—1st. Using iron of an improper thickness, or that of an inferior quality, in the construction of boilers; also, the too frequent use of cast-iron in steam and water pipes, and parts of boilers.

2d. Using boilers defective in form or workmanship, ineffectually staybolted or fastened; and also using boilers weakened by age or use.

3d. Employment of incompetent, reckless, or intemperate engineers.

4th. Using in the construction of steamboats, boilers, engines, paddle wheels, and machinery, without proper regard to the relative proportions which should exist between the different parts of the whole.

5th. Using inefficient or unsuitable pumping apparatus, and not providing for free and open passages for the water to the boiler, and afterwards for the exit of steam to the engines.

6th. In not providing a suitable or a sufficient number of safety-valves for the free and full discharge of steam when suddenly accumulating.

7th. Want of a proper and suitable system or mode of inspection of steam-boilers, engines, and machinery; want of suitable and uniform instruments for testing, by hydrostatic pressure, the actual powers of resistance of every boiler brought into use; and also an entire want of laws requiring an inspection of boiler-iron, or material for the construction of boilers.

8th. Want of competent and faithful inspectors, clothed with sufficient authority to regulate the conduct of engineers, and the management and general arrangement of engines and machinery, with power to establish a limit to excessive pressure, within the capabilities of the boilers to withstand it.

9th. Want of a board of supervising engineers, whose duty it is to exercise a general supervision over all boats or vessels navigated in whole or in part by steam, within the jurisdiction of the United States; and also to exercise a like supervision over boards of inspection, conduct of engineers, and others in charge of steam-engines.

Enumeration of the Causes tending to produce explosions, through the conduct of those in charge.—1st. Allowing water to get low in the boilers, through negligence, carelessness, or design.

2d. Overloading the safety valve, and permitting a dangerous accumulation of steam for the purpose of racing or wanton display.

3d. Through negligence in not blowing off steam when lying at a landing, or when the engines are not in motion.

He then proceeds to enumerate the remedies proposed, the most important of which are the organization of a Board of Superintending Engineers, who shall be the judges of competency in engineers, inspectors, and machinery,—and the adoption of certain improved apparatus to ensure abundant water, and conspicuous signals of approaching danger. Mr. Guthrie has contrived a new form of safety valve, to be regulated to such pressure as shall be found by experiment entirely safe in each case, and beyond the control of the officers of the boat. Also, a system of signals conspicuous to all passengers, which by an automatic and certain mentor will announce, "good water," "water getting low," or "water dangerous," as circumstances may require—and in the same manner, "steam safe," or "steam dangerous," ringing a bell at the same time. It is earnestly to be hoped that Mr. Guthrie's system of checks and contrivances to insure safety, should be immediately put to the most searching experimental proof by a commission of scientific and experienced men.

All the preliminary labor of investigation in this case has already been ably performed, and most valuable results reached by a commission of a similar character to that proposed, who about twenty years ago reported to the Franklin Institute at the request of the U. S. government—Prof. A. D. Bache, reporter. What now remains is to de-

vise a system of safety, and the laws and provisions needed to secure its adoption, and constitute a central board of Engineers, with power to carry the law into efficient operation.

2. *Records of the School of Mines and of Science applied to the Arts.* Vol. i. Part 1; *being Inaugural and Introductory Lectures to the Courses for the Session*, 1851-52. Royal 8vo. pp. 148. London, 1852.—It is well known that the Museum of Practical Geology and Geological Survey was established by the British government on a suggestion from Sir Henry de la Beche, the head of the Geological Department of the Ordnance Survey. This was in 1835. In 1845 the present liberal establishment was decided on, and without reference to expense, the museum building was erected with abundant accommodations for its collections, lecture and research rooms, and an ample Chemical Laboratory. The volume before us contains the inaugural discourse by the President, Sir H. De la Beche, in which a view of the inception, progress and prospects of this institution is given, with many facts and reasonings, having for their object to show the national and permanent importance of the institution. It is needless to say that this inaugural is marked by the high character which appertains to all the productions of the Nestor of British geology.

The other discourses are on the Study of abstract science, essential to the progress of Industry; by Lyon Playfair, C.B., F.R.S. On the relations of Natural History to Geology and the Arts; by Edward Forbes, F.R.S. On the importance of cultivating habits of Observation; by Robert Hunt, Keeper of Mining Records. On the Science of Geology and its applications; by Andrew Ramsay, F.R.S. On the value of an extended knowledge of Mineralogy and the processes of Mining; by Warrington W. Smyth, M.A., F.G.S. On the importance of Special Scientific Knowledge to the Practical Metallurgist; by John Percy, M.D., F.R.S. These discourses are eminently worthy of an attentive perusal.

3. *Annual of Scientific Discovery, A Year Book of Facts in Science and Art, for* 1852. Edited by DAVID A. WELLS, A.M. 12mo. pp. 408. Boston, 1852. Gould & Lincoln.—This is the third yearly volume of the "Annual," we have had the pleasure of noticing. Covering the wide range of Mechanics, Useful Arts, Natural Philosophy, Chemistry, Astronomy, Meteorology, Zoology, Botany, Mineralogy, Geology, Geography, and Antiquities, it is remarkable how much the editor has been able to compress within the limits prescribed to each subject. We have read with much satisfaction, and we may add instruction, the introductory notes by the editor on the progress of Science in 1851. No one can review this progress as mirrored in this résumé without being very deeply impressed with the great amount of labor and talent at present employed in gleaning the fields of old knowledge, or in pushing new pioneer paths into the wilderness of facts and principles lying in the way of investigation. Comparing this activity in 1851, and in the United States with any former year of our history, no doubt can be entertained that substantial progress has been made in all departments of science. Among the signs of this advancement, we may adduce the fact that this annual has found so great encouragement as to be continued for three years until we may now regard it as an established order.

4. *A Handbook of Organic Chemistry, being a new and greatly enlarged edition of the "Outlines of Organic Chemistry," for the use of students;* by WILLIAM GREGORY, M.D., F.R.S., E., Professor of Chemistry in the University of Edinburgh. 3d. edition, corrected and much enlarged. pp. 532. 12mo. London, 1852. Taylor, Walton & Maberly.—Chemists are very much indebted to Dr. Gregory for this new and very greatly improved edition of his excellent "Outlines," now well worthy of its present title. The author has taken great pains in bringing the work fully up to the present highly advanced state of the science, i. e., to the close of 1851.

The recent results of Würtz, Hoffman, Laurent, Gerhardt, and Cahours are introduced; and a valuable table of homologues is added, comprising the homologous compounds belonging to the radicals, ethyl, methyl, &c., as well as to acetyle, formyle, &c., derived from them; which table, although it extends to 17 vertical columns, and 22 horizontal ones, is yet but a corner of what might be drawn up, were we to have a column for every homologous series connected with the above groups of radicals. The author announces also a new edition of his Outlines of Inorganic Chemistry.

5. *Appleton's Mechanics' Magazine, and Engineer's Journal*, in 4to monthly numbers of 24 pp. Edited by JULIUS W. ADAMS, Civ. Eng. (No. 25 Nassau street, N. Y.) $3 per annum.—A Journal of high merit, and indispensable to all who would be acquainted with the recent applications of science to mechanics and engineering, and with the new discoveries in these and other allied practical departments of knowledge. Some idea of its range of subjects will be gathered from the following list of the papers of the number for June, viz.—Direct Acting Main Engine Plates; Longitude of Places, determined by Telegraph; Steam; Electro-magnetism on Railways; Engraving from Natural objects; Electro-metallurgy; Mechanics for the million; Lewiston and Queenstown Suspension Bridge; McCallum's Timber Bridge; Centrifugal power; Railway Axles, &c. &c. The plates are on steel or copper, and finely executed.

6. *The Naval Dry Docks of the United States;* by CHAS. B. STUART, Engineer-in-chief of the United States Navy. 4to. 24 fine engravings on steel. New Yok, 1852. C. B. Norton.—This book is a novelty in the history of American engineering, and we might add, in book publishing. The style of mechanical execution of the plates, the text, and all the accessories is such as we have been accustomed to regard as almost peculiarly English; and those who delight in the luxury of good workmanship and material will here find their taste gratified. Engineers must regard with great satisfaction works like this, designed to perpetuate and record their labors in the most honorable manner. The achievements of American skill and science are worthy of the vindication which this work supplies to the distinguished gentlemen of this profession in the United States, who have devoted their talents to our great works of public utility or defense.

This work is divided into two parts. The first describes the Granite Dry Dock, the second *the Floating Dry Docks.* To give any of the details or even the results of these great public works is foreign to our present purpose, and we will only add the hope that the success of this fine publication may be such as to induce our distinguished

author to undertake the treatment of other departments of our public works in the same elaborate and thorough manner.

7. *Graham's Elements of Chemistry* (2d edition,) has been issued from the press of Blanchard & Lea, edited by Dr. Bridges. It is only the first part, of course, as far as the close of the metallic bases of the earths; the second and final part has not yet appeared in England.

This work has a deservedly high reputation as a classic among the treatises on chemistry in our language, and Dr. Bridges' editorship is a guarantee for an accurate re-production of the English edition. He has also added valuable notes in correction or extension of the text.

8. *The Assay of Gold and Silver Wares: An account of the laws relating to the Standards and Marks, and of existing pay offices;* by Arthur Ryland. 12mo. pp. 212. London, 1852. Smith, Elder & Co. —This is entirely a technical book as its title shows, and is local to Great Britain. Those interested in these inquiries will find here much interesting and apparently accurate information.

9. *Lectures on the Results of the Great Exhibition delivered before the Society of Arts.* London: David Rouge. 12mo, (sixpence each.) —We have already* presented the lectures of Prof. Whewell and of Dr. Playfair to our readers. There have been twelve of this series in the following order:—

1. Rev. Dr. Whewell, Master of Trinity: The general bearing of the Exhibition on the Progress of Art and Science. 2. Sir H. De la Beche: Mining, Quarrying and Metallurgical Processes and Products. 3. Professor Owen: Animal Raw Products used in the Arts and Manufactures. 4. Jacob Bell, Esq., M.P.: Chemical and Pharmaceutical Processes and Products. 5. Dr. Lyon Playfair: On the Chemical Principles involved in the Manufactures shown at the Exhibition, as a proof of the necessity of an Industrial Education. 6. Professor Lindley: Substances used as Food. 7. Professor Solly: On the Vegetable Substances used in the Arts and Manufactures, in relation to Commerce generally. 8. Professor Willis: Machines and Tools for working in Metal, Wood, and other Materials. 9. James Glaisher, Esq.: Philosophical Instruments and Processes. 10. Henry Hensman, Esq.: Civil Engineering and Machinery generally. 11. Professor J. Forbes Royle: The Manufactures of India. 12. Captain Washington, R.N.: Shipping, particularly Life-Boats.

These of course are of unequal interest. Some of them are well worthy of the subjects discussed, others are less happy.

10. *Course of the History of Modern Philosophy;* by M. Victor Cousin; translated by O. W. Wight. 2 vols., 8vo. New York, 1852. D. Appleton & Co.—We can only announce the appearance of this translation of the eminent French metaphysician, just issued in handsome style by the Appleton's. The lectures, which are now for the first time in an English dress, were delivered by M. Cousin in the years 1828–9, and were received with great applause and admiration.

11. W. H. Buren, M.D., and E. E. Isaacs: *Illustrated Manual of Operative Surgery and Surgical Anatomy.* Part I. 84 pp., 8vo, with 26 steel engravings, by M. J. Léveillé. New York, 1852. H. Baillière; price with plates colored, $3.00, plain, $1.75.—The subject of

* Vol. xiii, p. 352.

operative surgery is illustrated in this admirable work by a large number of plates of exquisite finish, representing the instruments used, and also the various processes or modes of operation with different parts of the human body in all their details. The work is designed to serve as a companion to the ordinary text-books of surgery.

12. *Lectures on Histology, delivered at the Royal College of Surgeons of England, in the Session of* 1850, 1851.—Elementary Tissues of Plants and Animals; by JOHN QUEKETT, Assistant Conservator of the Mus. Roy. Coll. Surgeons of England. 206 pp. 8vo; illustrated by 159 wood-cuts. London and New York, 1852. H. Baillière.—Mr. Quekett, whose work on microscopes is well known, has embodied in his Lectures on Histology, a large amount of microscopic research, original and selected; and the abundant illustrations carefully made render the work a highly useful one. It treats of the microscopic structure of animal and vegetable tissues, of ducts, cells, juices, oils, and other parts in the intimate constitution of organic beings. Sections of wood, nuts, leaves, fruit, cartilages of different kinds, &c., are represented in detail. The work is a valuable companion to the microscope, directing the observer to many things of profound interest in the commonest objects around him, the study of which may afford constant instruction and rational amusement.

ISAAC LEA: On the Fossil Foot-marks in the Red Sandstone of Pottsville, Pa. (From the Trans. Amer. Phil. Soc., vol. x.) 14 pp 4to, with 3 lithog. plates.

ISAAC LEA: On a Fossil Saurian of the new Red Sandstone Formation of Pennsylvania, with some account of that formation. Also, on some new Fossil Molluscs in the Carboniferous Slates of the Anthracite seams of the Wilkesbarre Coal Formation. 20 and 4 pp. 4to, with 4 lithog. plates. *Philadelphia*, 1852. (From Jour. Acad. Nat. Sci., Part 3, vol. ii, 2nd ser. Read May 11, 1852.)

ISAAC LEA: A Synopsis of the Family of Naiades. 3d edit., greatly enlarged and improved. xx and 88 pp. *Philadelphia*, 1852.

ISAAC LEA: Observations on the Genus Unio, together with Descriptions of New Species in the Families Unionidæ, Colimacea and Melaniana. (Read before the Amer. Phil. Soc., and originally published in its Transactions,) Vol. v. 62 pp. 4to, with numerous plates. *Philadelphia*, 1852. Printed for the author.

The valuable memoirs here enumerated were received too late for any mention beyond that of giving their titles.

W. S. W. RUSCHENBERGER, M.D.: A notice of the Origin, Progress and Present Condition of the Academy of Natural Sciences of Philadelphia. 78 pp. 8vo. *Philadelphia*, 1852.

MAGNETICAL AND METEOROLOGICAL OBSERVATIONS at the Cape of Good Hope. Printed by order of her Majesty's government, under the superintendence of Lieut.-Col. Edward Sabine.—Vol. I. Magnetical observations 1841 to 1846, with abstracts of the observations from 1841 to 1850, inclusive. lxxii and 420 pp. 4to. *Lond.*, 1851.

MAGNETICAL AND METEOROLOGICAL OBSERVATIONS at Hobarton, in Van Diemens Land. Printed by order of her Majesty's government, under the superintendence of Lieut.-Col. Edw. Sabine. Vol. II. Commencing with 1843, with abstracts of the observations from 1843 to 1850 inclusive. 1 and 532 pp. 4to. *London*, 1852.

Das Quadersandsteingebirge oder Kreidegebirge in Deutschland, von HANNS BRUNO GEINITZ; 294 pp. 8vo, with 12 lithog. plates. *Freiberg*, 1849–1850.

Das Quadergebirge, oder die Kreideformation in Sachsen, Gekrönte Preisschrift von HANNS BRUNO GEINITZ, Dr. Phil. in Dresden. 44 pp. 4to, with 1 colored table. *Leipzig*, 1850.

Die Versteinerungen des Zechsteingebirges und Rothliegenden, oder des permischen Systems in Sachsen, von H. B. GEINITZ, und AUGUST VON GUTBIER. 4to, Heft i, 26 pp. with 8 lithog. plates of fossils, and Heft ii, 30 pp. with sections and 11 plates of fossils. *Dresden* and *Leipzig*, 1848–1849.

Considerazioni sulla Geologia della Toscana dei Professori CAV. PAOLO SAVI, *e* G. MENEGHINI. 244 pp. 8vo, with a large plate of sections.

PROCEEDINGS OF THE BOSTON SOCIETY OF NATURAL HISTORY, 1852.—p. 161. Descriptions of new species of Cyclas and Pisidium, (continued); *Prime.*—p. 165. Note on the embryo of the Dogfish; *J. Wyman.*—p. 166. On certain impressions upon a slab from the mineral region of Lake Superior; *Desor.*—p. 168. Observations on the Pedicellariæ found in Echini, &c.—p. 169. Observations on the Hillsboro' Coal.—p. 175. Note on the Rhinoceros; *Dr. Kneeland.*—Observations on the Coal measures of Ohio; *Dr. L. Lesquereux.*

PROCEEDINGS OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, vol. vi, No. for March and April, 1852.—p. 51. Aurora of Feb. 19; *Dr. J. C. Fisher.*—p. 52. Remarks on an Eocene cervical vertebra, probably Cetacean, and the institution of a new genus *Charodes* for the Hippopotamus Liberiensis of Morton; *J. Leidy.*—p. 53. Species of Hippopotamus from Northern Africa distinct from that of Southern Africa, as observed by Desmoulins and Duvernoy, and the name H. capensis, proposed by Desmoulins to be retained; *J. Leidy.*—Castoroides ohioensis from near Shawneetown; *Dr. LeConte.*—p. 54. Note on the periodicity of the Family Unionidæ, and on a new species of Unio from China, U. Cummingii; *J. Lea.*—p. 55. Molybdate of lead from Pennsylvania; *C. M. Wetherill.*—Observations on fossil Pachyderms from Illinois referred to on page 3 of the Proceedings; *J. L. LeConte.*—p. 59. Fossil tortoises of Nebraska terrestrial and not aquatic, with the names of the species as they should stand; *J. Leidy.*—Red Snow (Protococcus nivalis) from the Arctic regions; *J. Leidy.*—p. 60. New Birds from Texas of the genera Vireo, *Vieill*, and Zonotrichia, *Swains.* (Vireo atricapilla and Z. Cassinii); *S. W. Woodhouse.*—p. 61. Note on Carpodacus frontalis, *Say*, and descriptions of a new species of the same genus from Santa Fe; *G. A. McCall.*—p. 62. Description of new species of Reptilia from W. Africa, (Phractogenus (*Hal.*) galeatus, Hemidactylus angulatus, Acontias elegans); *E. Hallowell.*—p. 65. Remarks on some Coleopterous Insects collected by S. W. Woodhouse in Missouri Territory and New Mexico; *J. L. LeConte.*—p. 68. Characteristics of some new Reptiles in the Museum of the Smithsonian Institution, (Siredon lichenoides (B.), Cremidophorus tigris, Crotaphytus Wislizenii, Uta (B. and G.) Stansburiana, Sceleporus graciosus, Elgaria scincicauda (=Tropidolepis scincicaudus, Skilton, Am. J. Sci. [2], vii, 202), Plestiodon Skiltonianum, Phrynosoma platyrhinos (G.), P. modestum (G.), Churchillia (B. and G.) bellona, Coluber mormon, Heterodon nasicum); *Spencer F. Baird* and *Charles Girard.*—This number contains plates 12 and 13 of vol. v, of Proceedings, with colored figures of Hirundo scapularis, *Cassin*, Atticora hamigera, *Cas.*, Cypselus leucopygialis, *Cas.*, Acanthylis cinereocauda, *Cas.*

ANNALES DE CHIMIE ET DE PHYSIQUE, MARCH, 1852, tome xxxiv.—Nouvelles recherches sur l'acide hypériodique et les hypériodates; *M. Langlois.*—Recherches sur la populine (Extrait d'une Lettre de *M. Piria* à M. Dumas).—Mémoire sur le développement de l'électricité dans les combinaisons chimiques, et sur la théorie des piles formées avec un seul métal et deux liquides différents; *M. Ch. Matteucci.*—Recherches sur les eaux employées dans les irrigations; *MM. Eug. Chevandier* et *Salvétat.*—Nouveau mode de séparation de l'acide phosphorique d'avec les acides métalliques; *M. Alvaro Reynoso.*—Sur l'équivalent du phosphore; *M. Schrötter.*—Recherches sur quelques huiles employées dans la parfumerie; *M. A. W. Hofmann.*—Sur l'ether œnanthique et l'acide œnanthique; *M. W. Delffs.*—Sur les produits de la distillation sèche des matières animales; *M. Th. Anderson.*—Mémoire sur la dilatation de quelques corps solides par la chaleur; *M. Hermann Kopp.*—Note sur la polarisation de la chaleur atmosphérique; *M. Elie Wartmann.*—Sur les propriétés magnétiques des gaz; *M. Plucker.*—Comparaison du magnétisme de l'oxygène et du magnétisme du fer; *M. Plucker.*—Sur la polarité magnétique et la force coercitive des gaz; *M. Plucker.*—Second Mémoire sur les propriétés magnétiques des gaz; *M. Plucker.*—Sur le calcul de la surface de l'onde de Fresnel; *M. Beer.*—APRIL. Recherches sur les quantités de chaleur dégagés dans les actions chimiques et moléculaires; *MM. P. A. Favre* et *J. T. Silbermann* (Fin de la première partie.)—Mémoire sur la théorie des machines électromagnétiques; *M. H. Jacobi.*—Note préliminaire sur la mesure du courant galvanique par la décomposition du sulfate de cuivre; *M. H. Jacobi.*—Sur quelques sels et sur quelques produits de décomposition de l'acide coménique; *M. H. How.*—Sur l'acide uroxanique, un produit de décomposition de l'acide urique; *M. G. Stædeler.*—Sur l'existence de la créatinine dans l'urine de veau; *M. N. Socoloff.*—Sur la constitution et sur les produits de décomposition de la codéine; *M. Anderson.*—Fragments d'un Mémoire de M. J. R. Mayer, de Heilbronn, ayant pour titre: Remarques sur les forces de la nature inanimée.—Mémoire sur les effets calorifiques des courants magnéto-électriques et sur l'équivalent mécanique de la chaleur; *M. Joule.*

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ROUND ISLAND PASSAGE
Awakalo or Round I.
Within this Reef Sunken coral patches
Sail Rock
Anguega I.
Monkey Face Passage
Yandua
Rabe Rabe I.
Cocoanut Pt.
Kia I.
Passage
Mali Passage
Mathuata I.
Nucumbain Is.
Tuvuca I.
Vanua Levu
Nedle Pt.
Draytons Pt.
Asana
Ya Asava
Asavaiina
Androma
Otovawa
Mainthoma Levu
Naamia
Vangata
Shoal on which Porpoise Struck
Nariti I.
Beva I.
Fox I.
Eld I.
Agate I.
Sinclair I.
Waia I.
Waia lailai I.
Waiwailaithake
White Rocks
Vomo I.
Totten I.
Hudson
Cape Johnson
Eden I.
Passage
Wilkes I.
Underhill I.
Passage
Ferry I.
Malolo I.
Waldron I.
Sweden I.
Malolo Passage
Nanda Passage
Loku I.
Nacunga
Yasawa
Vatu Lele I.
Somosomo Strait
Dumpling
Bay Pt.
Bua
Vitiaturan
Richs Pt.
Springs Pt.
Vitilevu
Saliaki Passage
Saliaki I.
Ampana I.
Vilaniva I.
Lindsay Bay
Ovalau or Passage
Goro I.
Mokungai I.
Naingani I.
Nanumbalavu H.
Wakaia I.
Horse Shoe Reef
Levuka
Ovolau I.
Ambatiki I.
Motuiriki I.
Motuiriki Passage
Angasau Passage
Nairai I.
Cobra Rock
Mothea Rock
Bay of Amban
Viwa I.
Anakeo I.
Mauabualau I.
Angau I.
Kamba Pt.
Koro Pt.
Namisi Pt.
Nukulau I.
Mukulau I.
Nambaliiba Reef
Kalioki
Nanggara
Navua Bay
Navua Reef
Flood
Red Bluff
Grassy Bay
Storm I.
Bird I.
Nasaukn I.
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Shirts
Mbengha Passage
Romeraka I.
Black I.
Thompson I.
Vatu Lele I.
PASSED MIDSHIPMANS OR
Astrolabe Reef
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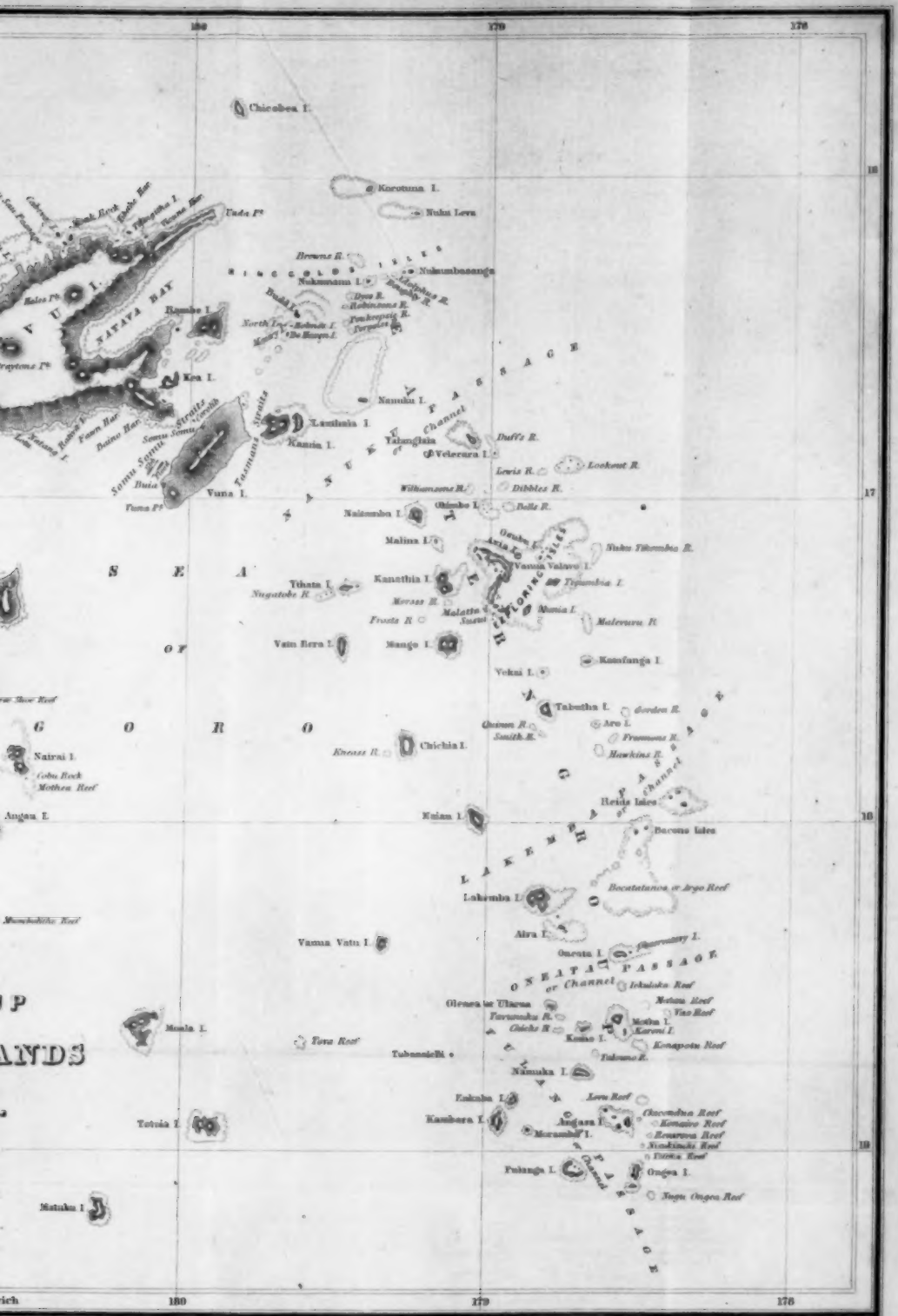
Sandford I.
Bentinck Island
Phillips I.
Hope I.
Wilson I.
Otea I.
Mallicolo Reef
Tabuera Bay
Kamava I.
CHART
OF THE
VITI GROUP
OR
FEEJEE ISLANDS
BY THE
U. S. Ex. Ex.
1840
179 Long. East of Greenwich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Chicobea I.
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Lewis R.
Lookout R.
Dibbles R.
Vuna I.
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Tibata I.
Kanathia I.
Malatta
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Malevuru R.
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Yeku I.
Tabutha I.
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Kuian I.
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Lakemba I.
Aba I.
Oneata I.
Vanua Vatu I.
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Tubanadi R.
Namuka I.
Kambara I.
Angara I.
Moramba I.
Fulanga I.
Ongea I.
Matuku I.
Tetoia I.
Ongea Reef
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